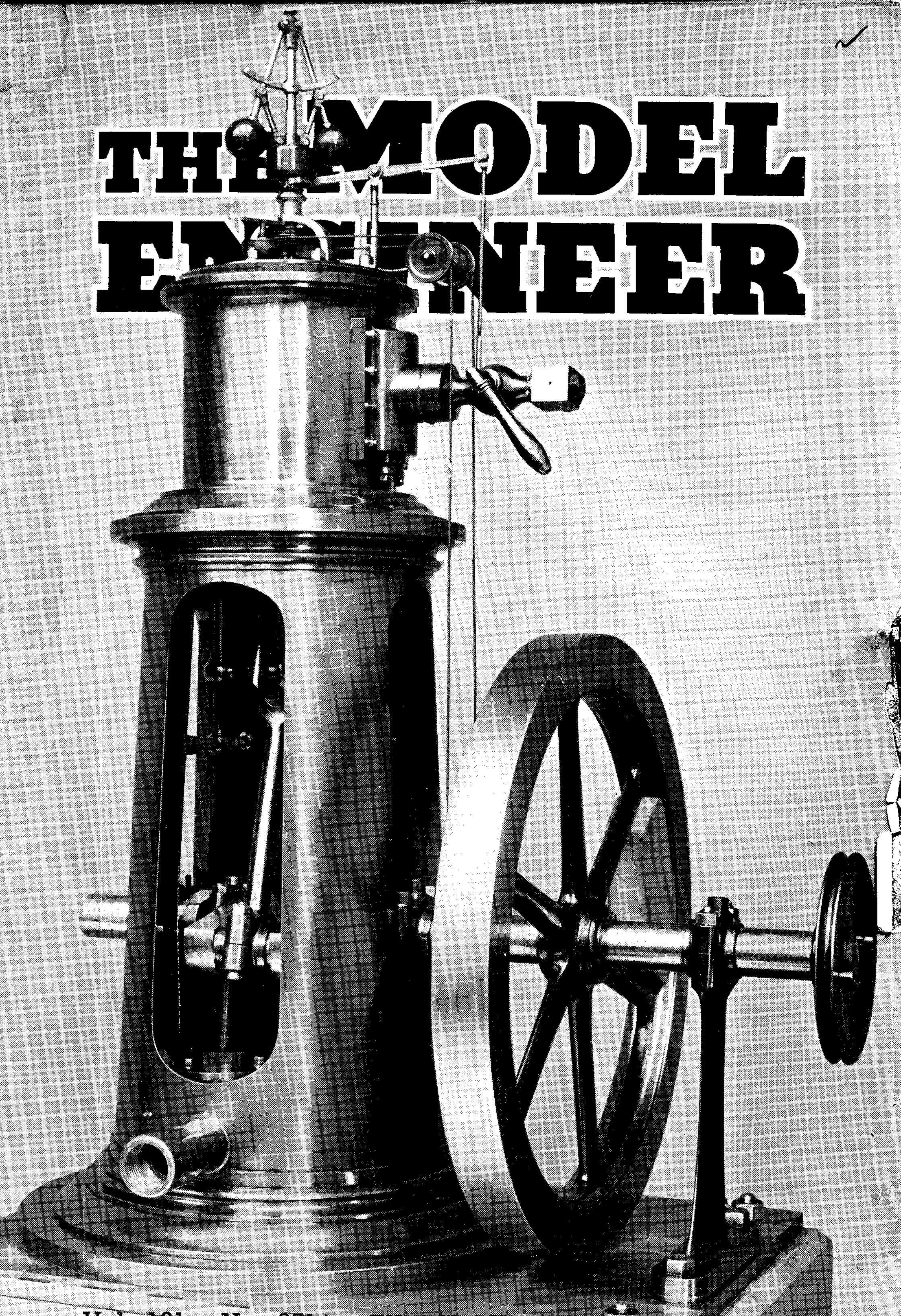
THE MODEL ENGINEER



Vol. 101 No. 2514 THURSDAY JULY 28 1949 9d.

The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

28TH JULY 1949 VOL. 101 NO. 2514

SMOKE RINGS

Our Cover Picture

● THIS HANDSOME example of a single-cylinder vertical pedestal engine was made by Messrs. Maudslay Sons & Field for driving a collection of models at the International Exhibition of 1862. It is of the condensing type, having a cylinder 4.1 in. diameter by 4.5 in. stroke, a jacket being provided around the cylinder through which the exhaust steam passes on its way to the condenser. The main crankshaft bearings are carried in the pedestal, and cylindrical crosshead guide-bars are fitted. Inside the base is a condenser and hot well, also a vertical air pump driven by an additional crank on the crankshaft. Steam distribution is by means of an ordinary D slide-valve, driven by an eccentric which also operates the feed pumps. A relief-valve is fitted to the feed delivery pipe to enable any excess feedwater, over and above that admitted to the boiler through the feed control-valve, to return to the hot well. The belt-driven governor is carried on the top of the cylinder casing, and controls the steam supply by means of a disc throttle-valve. Although this engine was not manufactured for commercial use, it forms a fairly typical example of the work of engineers of a period when tastefulness in design was not entirely subjugated to the requirements of sheer utility or facility of production. In this respect, it may be regarded as representing an intermediate phase between the highly ornate and sometimes needlessly elaborate design of the table and steeple engines, and the more severe design of the modern type of vertical engine. (*Crown Copyright. From an exhibit in the Science Museum, South Kensington.*)

Tamworth Winners

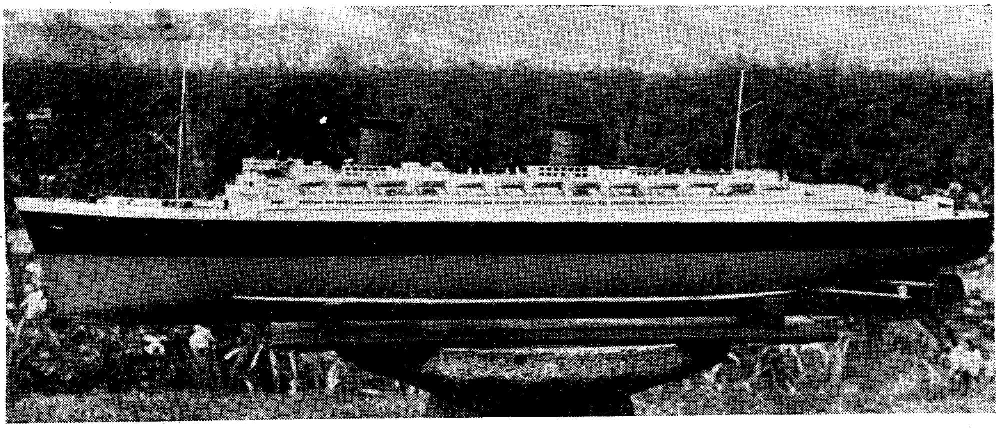
● TWO PRIZES, donated by Percival Marshall & Co. Ltd., in connection with the recent exhibition organised by the Tamworth and District Model Engineering Society, were awarded as follows: One, a subscription for one year to THE MODEL ENGINEER, and a copy of F. C. Hambleton's book, *Locomotives Worth Modelling*, went to Mr. J. Brown, of Shuttington, for a very fine 3½-in. gauge "Juliet."

The other prize, a year's subscription to THE MODEL ENGINEER, and a copy of "Jason's" book, *Ship Modelling Hints and Tips*, was won by Miss M. A. Sutton, of Two Gates, near Tamworth, for a 3-ft. yacht.

We hope these prizes will help to inspire both winners to further efforts, and we are especially glad to note that one of the successful contestants was a lady. We would add that we also hope to be able to publish an illustrated description of each of the two models concerned.

"M.E." Exhibition Posters

● THE STRIKING poster advertising the "M.E." Exhibition is now ready. Copies will gladly be sent to anybody who is kind enough to wish to display them. Application should be made to the Exhibition Manager, Percival Marshall & Co. Ltd., 23, Great Queen Street, London, W.C.2, as soon as possible. Handbills are also available for any reader prepared to assist by distributing these.



A Good Start

● THE PHOTOGRAPH reproduced on this page is of a model of R.M.S. *Queen Elizabeth* described by its builder, Mr. S. B. Whitmore, of Derby, as his first attempt at modelmaking. He must be congratulated on having produced a very proportionate and very handsome ship model. In his accompanying letter, Mr. Whitmore explained that he made a few "toy" boats when a schoolboy over 25 years ago, but that it was not until an illness some eleven months ago that he took up model engineering. To quote from his letter :—"The hull was dug out of a piece of pitch pine 40 in. × 5 in. × 5 in., not really suitable for the purpose, but it was all that was available at the time. The superstructure is of sheet copper and zinc, and the decks of $\frac{1}{8}$ in. plastic sheet, painted, lined to represent planking, and varnished. I'm afraid the photograph does not show the deck fittings very clearly, nor are the rails visible, the latter were made from steel wire (banjo strings) soldered to uprights (domestic pins cut short).

"This is a working model, so is a little over scale under the water-line. It is powered by two electric motors and will run for a considerable time on two cycle-type dry batteries at well above scale speed. There are four propeller shafts and screws as on the prototype, but the inner two only are connected to the motors, the outer two being dummy.

"The model took just over twelve months to build, but I also have made concurrently with this a "OO" gauge G.W.R. "King George V" locomotive complete with three coaches.

"I am about to commence a $3\frac{1}{2}$-in. gauge "Hielan' Lassie." This is my first attempt at "live steam" work, and I was very nervous at attempting this until I read of Mr. Webb's effort in THE MODEL ENGINEER dated May 19th, 1949."

And so the good work goes on. A description of *your* model with a photograph might induce a would-be modelmaker to advance beyond his dreams and to get really down to the job.

An Exhibition in Bristol

● AN IMPORTANT model engineering exhibition is to be held in Bristol from August 6th to 17th. An interesting feature is that it is being organised by the Bristol Joint Model Clubs' Committee. This was the outcome of the committee which was formed in 1945 to organise a joint model clubs exhibition. The clubs represented were the Bristol Society of Model and Experimental Engineers, the Bristol Model Yacht Club, the Bristol Railway Circle, The Bristol Ship Model Club, The Bristol and West Model Aero Club and The Bristol Model Power Boat Club. The committee consisted of two members from each club. At this exhibition, which was held early in 1946, the attendance so far exceeded the anticipation of the organisers that the crowds had to file past the exhibits on a one-way system. After the exhibition, the clubs felt that the committee could help the clubs in many different ways, so it was continued. It has done valuable work in many directions, not the least being in getting the City Corporation and the City Museum interested in the work of the various clubs. Since the last exhibition, two new clubs have been formed in the city, the Bristol and West Model Race Car Club and the Bristol 7.4.2 Club, and these are also represented on the committee. There certainly is strength in unity and we commend the idea of forming such a committee in any big city or area in which a number of clubs exist. Some cities have one big club with sub-sections representing the various interests; but there are many advantages in running the clubs independently, each having its own chairman and secretary, and forming the connecting link by means of a committee such as that which has worked so well in Bristol. Particulars both of the exhibition and the committee, and its workings, may be obtained from the Secretary, Mr. E. C. H. Smith, "Elm View," Shortwood, Mangotsfield, Nr. Bristol.

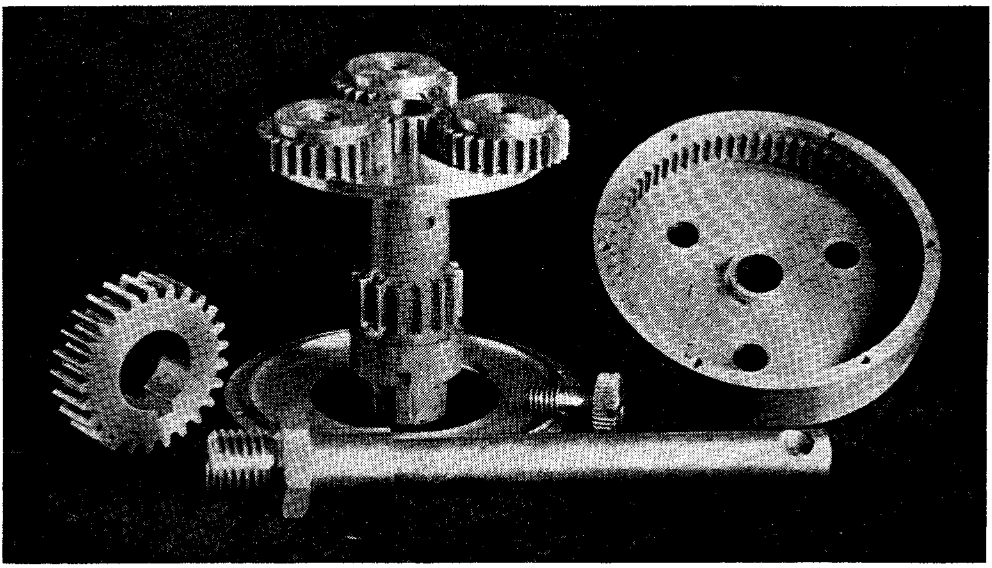
"FINE FEEDS"

by E. G. Smith

"I WISH I had a *REALLY* fine feed ! ! "
How many owners of small lathes have not at some time or other expressed that wish ?

All those of my acquaintance do so as a fairly regular thing, and I also used to join in the chorus until at last I found time to work out an idea which had been simmering for a long while. viding a first drive pinion on the gear with 15 teeth where the standard train would have a 25-tooth wheel. The 25-tooth screw-cutting wheel is now fitted on the end of the epicyclic gear to mesh with, and take the drive from the tumbler gears.

Provision is also made for the body set-screw



The gear partly dismantled to show internal arrangement

to be removed from the boss, passed through the back of the body and screwed into one of the planet wheel pins, thereby locking the gear and making a solid drive to provide the feeds shown in the second column of Fig. 1. At first sight, the length of the fitting may appear to be greater than necessary, but this is such as to allow room to change the front wheels on the two quadrant studs for feed variations without having to remove the gear, whilst the diameter of the body is such as not to restrict the use of the hollow mandrel. For screw-cutting purposes the gear is slipped off and replaced by the standard fitting, a simple distance-piece being used to take up the extra length of the special stud.

The experiment proved successful, and as a result, I now have available a range of feeds varying from fifteen "thous." to less than half a "thou." by the simple exchange of two wheels. (See Feed Table, Fig. 1.)

So successful has this proved that, believing my own small circle of friends to be a fairly representative cross-section of small lathe users as a whole, I make no apologies in offering a detailed description to fellow readers of THE MODEL ENGINEER. In doing so I feel quite confident that if any other reader cares to take the trouble to make up one of these attachments for himself, he will find the time spent in construction to be well worth while.

The accompanying photographs will give a fair idea of general arrangement and appearance, and also of what may be done when the feed can be got down to something really fine.

In general, the attachment consists of a special tumbler stud carrying an epicyclic gear in place of the standard fitting for the first drive pinion. This epicyclic gear gives a reduction of five to one, and a further reduction is obtained by pro-

The gear illustrated was made entirely on a Myford M.L.7 including all gear cutting, and with the exception only of the planet wheel pins, set-screws and special stud, is constructed throughout in brass or gunmetal. Granted that this is theoretically wrong, it, however, makes for much easier working in construction and gives every promise of being entirely satisfactory in use on a machine which is only used for a hobby

Driver	1st Stud	2nd Stud	L/screw	FEED	
				Gear in Action	Gear Locked
15	65-20	70-20	75	0.00044	0.0022
,,	,, -30	60- ,,	,,	0.00076	0.0038
,,	,, -35	55- ,,	,,	0.00098	0.0049
,,	,, -40	50- ,,	,,	0.0012	0.0062
,,	,, -50	40- ,,	,,	0.0019	0.0096
,,	,, -55	35- ,,	,,	0.0024	0.012
,,	,, -60	30- ,,	,,	0.0034	0.015

FIG. I.—FEED TABLE

Dividing for the gear wheels, etc. was done with a home-made dividing attachment working through the bull wheel of the back gear, teeth being cut with a form tool on the top-slide. For this purpose the top-slide feed screw was removed and a small lever fitted to the slide, enabling it to be used as a small hand shaper, the tooth depth being read off on the cross-slide indicator. This is a subject which could be enlarged upon considerably but hardly comes within the scope of this article, and it must suffice to say here that I consider this to be the simplest and most economical method of gear-cutting for the amateur, whilst it is about the only method for cutting an internal gear wheel such as is needed for the fitting under review.

Adaptable

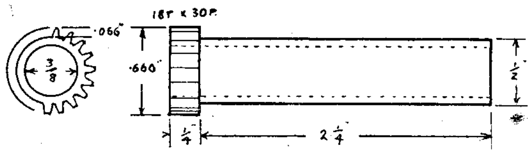
The following instructions and dimensions relate particularly to the M.L.7, but with adjustment of dimensions where differences occur, the fitting may be adapted to any other make of lathe. It might even be adapted to work on a special quadrant-stud for the smaller types of lathe having no tumbler reverse.

cross-slide indicator, thus forming a clearance for gear cutting. The wheel should now be turned to finished size and the teeth cut to a depth of 0.066 in.—the depth of all teeth in the epicyclic train. When gear cutting is completed, finish turning the bush, *bore* the hole to within two or three "thous." of size and finish with a $\frac{3}{8}$-in. reamer. It is important that the bore, outer diameter and wheel should be true to each other within close limits, and the method of operation outlined above will ensure the desired result being obtained.

The sleeve for the central bush, Fig. 3, may be made next, care being taken in boring to obtain a good press fit on the end of the central bush. The outer end is turned to fit the 25-tooth screw-cutting wheel, and if at this stage the keyway is cut and the key fitted—well, it's nice to feel that a part is completed. When the key is fitted, sweat it in position and save crawling around the floor hunting for it at some future date!

Spider and Planet Wheel

The next stage, building up the spider and



Fib. 2. *Central bush and sun wheel*

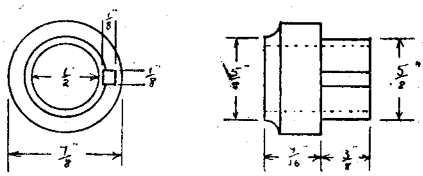
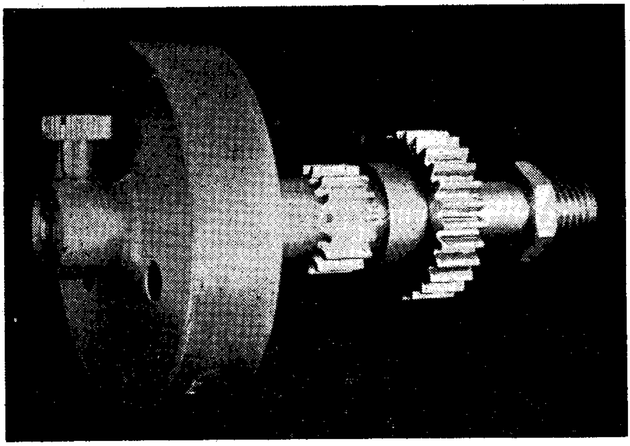


Fig. 3. *Sleeve for central bush*

In construction, the first item to be made is the central bush shown in Fig. 2, on which the 18-tooth sun wheel is cut in the solid. This part is turned from a piece of $\frac{3}{4}$ in. diameter hard brass, the gear wheel end being nearest the chuck. (A 4-jaw chuck provides a much firmer hold than a self-centring, and is worth the extra trouble in setting up.) Drill out with a $\frac{5}{16}$-in. drill to a depth of about $2\frac{5}{8}$ in., rough turn the outside diameters to within 0.015 in. of finished size, then put a parting tool in behind the wheel to a depth of about 0.080 in. on the

planet wheel assembly, Fig. 4, is, I think, a really interesting one, and by the time this is complete one begins to feel that the job is really getting on. The planet wheels may be tackled first and are made together from a piece of 1-in. round hard brass; again the piece should be first drilled $\frac{1}{16}$ in. under bore size and a parting tool put in at the back end for clearance in gear-cutting before finishing the outside diameter. I do not give a length, as this depends on the parting tool to be used; it should be rather more than $\frac{3}{4}$ in. (three wheels) plus twice the width



An epicyclic reduction gear for really fine feeds

When turning the spigot, a $\frac{7}{16}$-in. drill may be put through the centre, thus reducing the amount of metal to heat in soldering.

The part is now mounted in the 4-jaw chuck, holding the outside of the plate and setting up so that the face of the plate and the outer end of the boss runs fairly true. Finish turn the boss and wheel and cut the 15-tooth pinion to fit the screw-cutting wheels belonging to the lathe ; a tooth depth of 0.100 in. should be about right, but be sure they are cut deep enough. Once again the hole is the last operation and this should be bored to a good running fit on the central bush. The spider is next put on a mandrel and the outer face of the plate skimmed taking off only just enough to clean it up ; while the job is on the

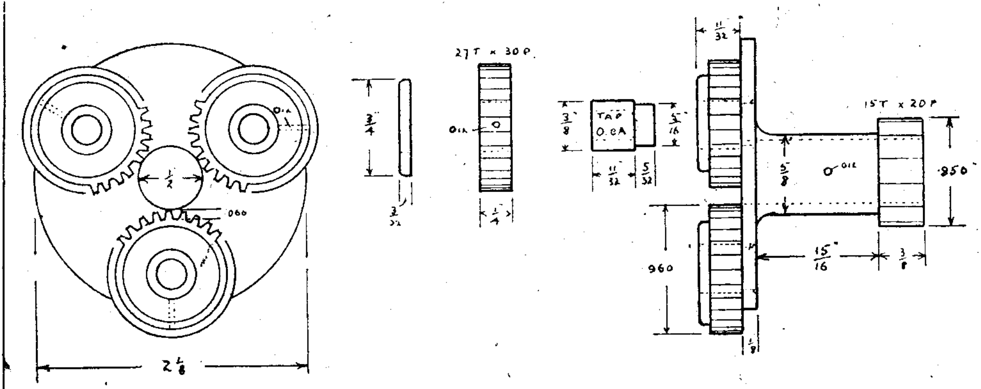
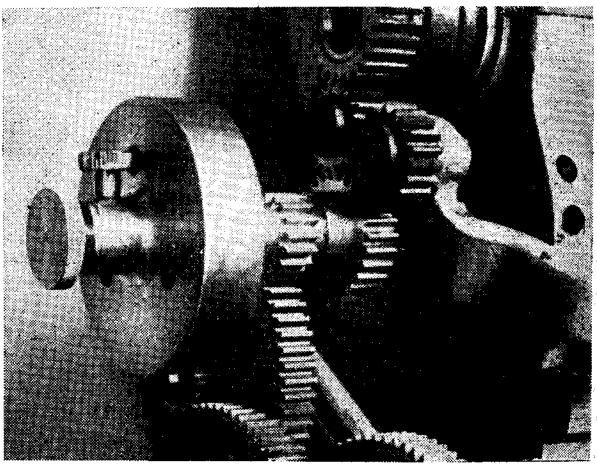


Fig. 4. Details of planet wheels, spider, and final drive pinion

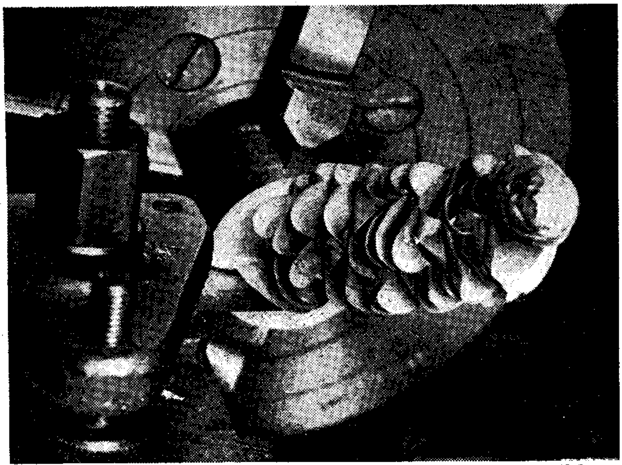
of the tool. Cut the teeth (27) to the same depth as before, making sure that they mesh freely with the teeth of the sun wheel. The hole may then be finished, either bored to size or *bored* and reamed, and the three wheels parted off.

Failing the material to make the spider in one piece, it may be built up from a piece of $\frac{7}{8}$-in. round hard brass and a piece of $\frac{1}{8}$-in. hard brass plate silver-soldered together ; if this procedure is adopted, be sure that both pieces are " hard," or undue annealing will occur in soldering. I favour making the plate first, leaving about $\frac{1}{16}$ in. on the outside diameter and boring a $\frac{5}{16}$-in. hole in the centre for the spigot, as it is easier to fit the spigot to the hole than it is to bore the hole to the spigot ; don't touch the faces of the plate at this stage.



The epicyclic gear mounted on an " M.L.7 "

mandrel, bring the dividing attachment into operation once again to mark off the position of the planet wheel pins, striking off the radial centre-lines for these with a scribing block.



One benefit of an extra fine feed. A piece of $1\frac{1}{2}$-in. round mild-steel faced right away with one cut $\frac{3}{4}$ in. deep and a feed of 0.0012 in.

Care Needed

The next operation, drilling the plate for the planet wheel pins, needs care, but it is much simplified by making a simple locating-jig for the job. In one end of a piece of $\frac{1}{8}$-in. plate, bore a $\frac{1}{2}$-in. hole to fit the central bush, then assemble bush and spider with this plate between the sun wheel and spider face. Turn a short plug $\frac{1}{4}$ in. or $\frac{5}{16}$ in. long to press into one of the planet wheels and drill a $\frac{1}{8}$-in. hole through the plug; it is important that this hole should be true in the plug, and if the drill runs off centre at the first attempt, face off and start again. Press the plug into a planet wheel, mesh the planet wheel with the sun wheel on top of the $\frac{1}{8}$-in. plate, and with a strip of thin paper between the teeth to provide for a working clearance, clamp in position and drill through the central $\frac{1}{8}$-in. hole into the jig plate, taking the plate off to complete drilling through, and the jig is ready. Reassemble central bush, jig and spider, locate $\frac{1}{8}$-in. hole centrally over one of the radial lines scribed on the spider face, clamp in position and drill a $\frac{1}{8}$-in. pilot hole through spider flange. Repeat for the other two pins, then the three holes may be opened up to $\frac{5}{16}$ in. and countersunk. Take care of the drilling jig, as we shall have another job for this later on.

Pins and Washers

The planet wheel pins should be turned all over from a larger piece of mild-steel in order to ensure truth between the two diameters, and are drilled and tapped in the self-centring chuck before fixing; a shallow countersink in the small-end will be found to greatly facilitate riveting. Rivet firmly into the spider, using care and quite a light hammer to avoid distortion, and a piece of soft sheet metal (copper or aluminium) between the pins and anvil to avoid burring the front ends. The spider may now be remounted on the mandrel to face off any surplus metal from riveting and to clean up the back of the plate.

Three retaining washers are now parted off from a piece of $\frac{3}{4}$-in. round after boring to a press fit over the planet wheel pins; drill oil-holes in the spider and wheels, and the whole may be finally assembled. Fit the central bush and sun wheel, make sure that everything works freely, presss the drive sleeve into position on the central bush and the assembly is complete; before laying it on one side, put the $\frac{3}{8}$-in. reamer through the centre hole once more, as the walls of the bush are thin, and if the sleeve is a really good fit it will close the bore in a trifle.

I think it highly probable that the next item, the body, Fig. 5, will present the greatest problem for material. I was fortunate in finding a good gunmetal casting which, with the addition of a piece of 1-in. round, silver-soldered in to form the boss as shown on the drawing, was just right for the job. Failing this, undoubtedly the best procedure is to make a pattern and have a piece cast specially; a good clean close-grained casting in cast-iron would be quite suitable.

Machining

In machining, the first step is to chuck the casting with the jaws inside and rough turn the outside diameter, outer face and boss; then turn it round and holding on the boss, rough turn the inner surfaces, etc. to within about 0.025 in. of finished sizes. The small boss on the inside may now be finished, making the outside diameter of this a good fit to the $\frac{1}{2}$-in. hole in the drilling jig made for the spider. With a 3/32-in. recessing-tool, form the front recess which takes the back cover plate, carefully boring out until the three planet wheels mounted on the spider will just fit in; then take another 0.005 in. cut using the cross-slide indicator to set for same, and we have got root diameter for the internal gear allowing a comfortable working clearance. DO NOT finish the outer face at this stage. Note the indicator reading last used and repeat this in forming the recess behind the teeth (an additional 0.005 in. depth here is an advantage rather than otherwise), then add 0.066 in. to the reading and at this new setting, finish the inside diameter of the gear, and same is ready for cutting. It will now be apparent why, in Fig. 5, the recess diameter is only given as "approx." and no internal diameter is given for the gear. In cutting this gear it is advisable not to cut the teeth to full depth to begin with, but to go round on a depth of about 0.060 in. or 0.062 in., then try in the spider assembly for fit. If the wheels won't go in or are tight, deepen the teeth a few thous. at a time until the whole assembly works sweetly; a little extra trouble taken over this operation will be well repaid.

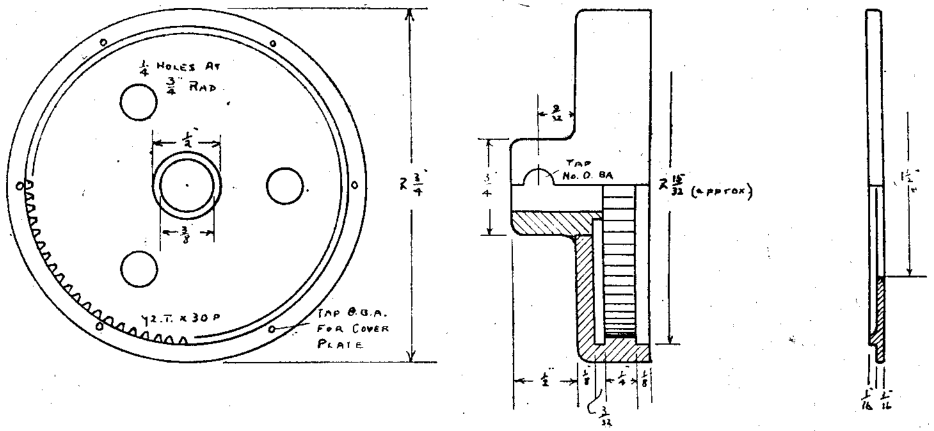


Fig. 5. Details of body with internal gear, and cover plate

Before removing the dividing attachment, strike off the radial centre-lines for the three holes in the backplate as before, and then the outer face may be finished. To do this, place the spider assembly in position and, with the saddle locked, set a facing tool to just touch the back of the spider plate, withdraw the tool 0.002 in. via the cross-slide indicator and finish the face to this setting; the spider assembly can easily be removed before facing without disturbing the tool setting. Lastly, bore and ream the centre hole and turn the outside diameter to finished size. The back face and boss are not important and may be finished holding on the outside diameter in the self-centring chuck, taking care not to tighten the chuck sufficiently to distort the gear. Drill and tap the boss for the set-screw and drill the three ¼-in. holes in the back, using the spider drilling-jig to locate these in position.

The Back Cover

Select a flat piece of ⅛-in. plate for the back cover plate and bore the centre hole just large enough to go over the jaws of the self-centring chuck. Holding inside this hole, all important faces (i.e., the two inner faces, spigot and outside diameter) may be finished at one setting. The spigot should be a light press fit in the body recess and both inner faces must be on exactly the same plane, a result which can easily be achieved by using the top slide indicator to transfer the finishing cut over the spigot. The plate may then be lightly held on the outside of the spigot and the hole and outer face carefully finished. Set out for fixing-screws, clamp the plate in position on the body and drill tapping holes to full depth, afterwards opening out the holes in the plate to clearance size and countersinking. The gear may now be completely assembled and is ready for use.

The remaining pieces, Fig. 6, are plain straightforward turning, needing no detail instructions; one final point only I have to make and that is, fit the new stud to the lathe and mark this for the set-screw countersink (or flat) with everything set up in position, so ensuring that the set-screw is always handy to get at.

And for your trial run, here's wishing you "FINE TURNING."

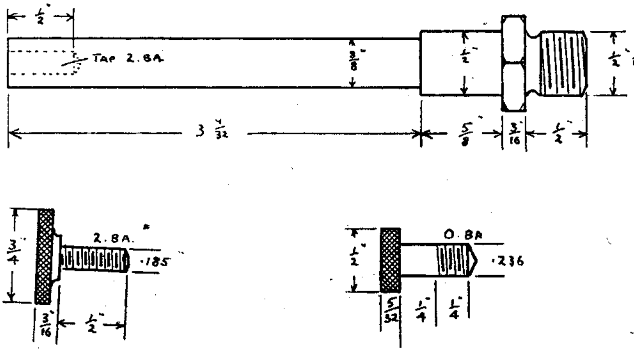


Fig. 6. Above—Special tumber stud; left—retaining screw; right—gear set-screw

A BLOWLAMP TIP

I HAVE frequently read about a burner getting blocked, and many people suggest filtering the paraffin and pricking the burner. After a few years wear the pricking becomes more and more frequent, and life a burden. I find a *complete* cure is to pack a small wad of steel wool in the recess behind the jet, and there is then no further pricking required. I haven't pricked mine for months, and get a perfect flame.

Also, the blocking of the burner is not due to foreign matter, but to a splitting of the paraffin molecules with a deposit of fine carbon (a modified "cracking").—H. STOCKER HARRIS.

Too Permanent?

by "L.B.S.C."

SOME of the followers of these notes are of the opinion, that whilst I give drawings and instructions for building locomotives that will do the job, I don't have much to say about providing a line for them to run on. They add that a good engine needs a good road, to give of its best. With that, I certainly agree; but it was said of a famous locomotive-cum-civil engineer of ancient days, who not only designed locomotives, but surveyed and laid out many hundreds of miles of line, that the engines were his pets, and he only looked at the line from the viewpoint that they provided a means of running the said engines. Well, I must confess that your humble servant is by way of being tarred with the same brush; but I try my best to please, so let's investigate a query of two that has come in from the "civil engineering department," regarding the rigidity or otherwise, of a small railway.

The question of rigidity is one which has caused many full-sized railway engineers plenty of headaches. Old man Brunel (he wasn't an old man, by long chalks, at the time!) reckoned he was going to have the last word in permanent way on the broad gauge Great Western Railway; so he had wooden piles driven in at close intervals, put huge longitudinal baulks of timber on top of them, and laid "Bill Massive" bridge-type rails on top of the baulks. The p-way gangs nicknamed it the "baulk road." It was rigid enough—so rigid that it wouldn't "give" a fraction under the weight of the engines, and caused them to ride so roughly that springs in galore were broken. I recollect reading in an old book, a description of a footplate trip on one of the old broad-gauge single-wheelers, over a section of the "baulk road." The writer said that he had to hold on to the handrail, for all he was worth, to avoid being thrown off; and his body ached all over when the trip was finished. The engine's name was "Tartar," and he said she was, too! The rigidness of the road was partly responsible for the use of open-plated springs, in which the extra-long plates are separated by packing-pieces between them. The packing-pieces are short, and keep the plates apart at the centre, so that the springs are very flexible.

When the Central London tube railway was first opened, between the Bank and Shepherd's Bush, the permanent-way was very similar, being composed of bridge rails on longitudinal sleepers. The vibration of the heavy electric locomotives, which weighed somewhere around 50 tons and were known as "Long Toms" (they had a centre cab, sloping ends, and ran on two four-wheeled bogies) was transmitted *via* the unyielding road, to the iron tunnel, and thence to the earth. The shopkeepers all along Holborn and Oxford Street kicked up such a shindy, saying that a miniature earthquake took place every time a train passed underneath, that the locomotives were taken off, and multiple-unit trains used instead. However, the vibration never entirely disappeared until the "Central" was merged into the London Underground group, and the old track replaced by ordinary chaired rails on cross sleepers.

Experiences Differ

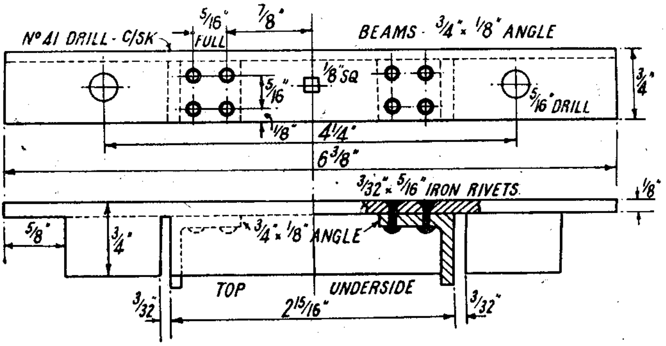
Coming down to our little railways, there seems to be a difference of opinion as to whether a road should be absolutely rigid or not. For example, a correspondent complains that when riding on a little line, composed of strip-iron rails laid on an all-concrete substructure (sort of concrete viaduct) the riding was harsh, uncomfortable, and fatiguing. Another one says that on an all-timber construction, with brass rails laid direct on the longitudinals, it was nothing but derailment after derailment, owing to the longitudinals becoming distorted, partly due to weather effects, and partly to the heavy loads carried on four-wheeled cars. In both cases, the cars were composed of plain seatboards, and the wheels were not sprung. The first-mentioned was a bogie car, the wheels having independent bearings, and the bogie frames being free to rock on a pivot pin between the two axleboxes. The second was a plain four-wheeler, also unsprung, but the wheels were fixed on the axles in the usual way.

Now in my humble opinion, if the first-mentioned car had been properly sprung, the riding would have been all that could be desired. On my own railway, which had wooden longitudinals on concrete posts, and the rails laid on cross sleepers, and, therefore, a certain amount of resilience, there is all the difference in the world between the riding qualities of a sprung car, and one that is springless. I still have one of my old original testing cars, in which the bogies are merely oak blocks with the ball-bearings sunk in pin-drilled recesses in them. This car rides "hard," and every joint in the rails is transmitted to the rider's anatomy; but it keeps the road well, and the riding isn't fatiguing, as there is a certain amount of resilience in the sleepers and longitudinals. Another of my cars has proper coil springs in the Bettendorf-Andrews type bogies and yet another has tramway-car pattern bogies, the seatboard being carried on blocks of sponge rubber. Both these cars are very comfortable—incidentally, they need be, when I have done five miles at a "session," doing some experimental running, though they begin to be a bit reminiscent of the old London, Chatham and Dover, or North London "thirds" when one is getting toward the end of the journey!

Rigidity Preferred

From my own experiences, plus reports from

various correspondents in all parts of the world, I think that an absolutely rigid small line is best, for several reasons, the two most important being that an all-concrete substructure remains true and ensures a level roadbed without the need of attention, and the rolling-stock doesn't derail. If there is no cross-winding or undulation, even a springless toy locomotive will stay on the metals renewal. As to the respective merits of brass—or rather brass alloy—rails, and those of steel, to my way of thinking, it all depends on the amount of traffic. My own rails are of extruded alloy, a sort of hard-drawn brass. They have been in use on the "non-stop" line now, for some thirteen years. Previous to that, a number of them were in service on my old original up-and-down



Buffer beams for "Tich"

at a considerable speed. Another aspect is put forward by our good friend Dan Hollings, of the West Riding Small Locomotive Society (I just love that title—no suggestion of the "toyshop" there!) who says that in the Blackgates Railway, they aimed at making a line which offered the absolute minimum of rolling friction to the locomotives and cars. Apart from the fact that the substructure weighs something like 100 lb. per foot run, the rectangular steel tubular rails are fitted to milled grooves in channel steel sleepers secured by bolts in the concrete. This gives an unyielding "roller-bearing" surface for the wheels to run on. Now the difference between this and a full-sized railway, is just the fact that whilst in the latter, the weight of, say, a twenty-coach train is spread over a length of approximately 1,200 ft. or more, and rests on 80 axles, an equivalent load on the Blackgates line (or any other small railway, for that matter) *is squeezed into a length of about 6 ft. and rests on four axles only.* It doesn't need a Sherlock Holmes to deduce that if the small railway is laid with a resiliency equivalent to that of its full-sized relation, such a concentration of weight and rolling friction would play Old Harry with it. The effect would, in a manner of speaking, be like a full-sized train running over a road laid on rubber sleepers.

Friend Hollings's argument is perfectly reasonable. Except in the case of tiny engines which are just intended to be children's toys, I always specify full springing, which will take care of any tendency to "ride rough" on the part of the locomotives. As for the passenger cars, it is perfectly easy to fit either proper springs, or failing those, to insulate the seatboards with sponge rubber, and so ensure comfort for the passengers. Once a concrete-and-steel road is laid, and opened for traffic, it should need practically no attention until the rails need line, so they have a further six years to their credit. Wear is negligible; they will most probably "see me out," although there is a considerable amount of traffic passing over them. The only time I am ever troubled with slipping, is when one or other of my few personal friends brings an engine along for a run, and drops oil or grease on the railheads, as happened on a recent Saturday afternoon. Then I have to get busy with some paraffin.

Alongside of my oval line, is a straight one 108 ft. in length, taking locomotives from $2\frac{1}{2}$-in. gauge, up to $7\frac{1}{4}$-in. gauge. This is made from steel bars, held together by bolts and spacers. It is seldom used; consequently, the railheads are rusted and pitted, and it is like running over a macadam road to ride on it at the present time. The trouble is, of course, the lack of use; if a frequent train service ran over it every day, the railheads would be as shiny and smooth as the heads of the brass rails alongside. Whether the Blackgates line will have enough traffic to keep the railheads smooth and bright enough for the "roller-bearing" effect, remains to be seen. The resistance to wear, can be judged by a comparison between the steel rails at Blackgates, and the brass ones at Birmingham, after a couple of years have passed; the amount of traffic would, of course, have to be taken into consideration. Time proves all things! All I can say in conclusion is, that if I ever had the opportunity, I should do away with the wood longitudinals on my own road, and replace them with light steel girders, retaining the sleepers and the brass rails.

Safe Couplings

Just one more item. I have heard of several cases where a little engine has kind of "slipped coaches," breaking away from the train, eluding pursuit, and damaging itself either by derailment

or collision. This can easily be avoided by using a simple chain coupling, split-pinned at both ends, so that the pins cannot come out; or else using the locomotive's own coupling, passing the shackle, or end link, between the jaws of a fork on the drawbar of the car, and putting a split-pin through the lot. The split-pin should be opened out a little—it doesn't need much opening to prevent it jumping out—and the ends squeezed together whilst putting it through fork and coupling. When you let go, the natural spring of the metal will keep it in place. An ordinary chain or shackle, slipped over the usual type of drawhook, is all right in the back garden, but not safe enough for a club or other public line, as the chain or shackle usually manages to jump off the hook on the slightest provocation.

Beginners' Corner—Buffer Beams for "Tich"

The buffer beams for "Tich" are made from $\frac{3}{4}$-in. by $\frac{1}{8}$-in. angle; steel for preference, but brass will do as a substitute if steel angle cannot be easily obtained. Two pieces long enough to finish to an overall length of $6\frac{3}{8}$ in. will be needed. Mark them off with your try-square; saw just a weeny bit longer than finished size, and trim up the ends by filing to the marked line. Then saw away half of the angle for a distance of $\frac{5}{8}$ in. at each end, as shown in the top-and-underside view, filing away the saw-marks. Next, using the try-square again, carefully mark off the position of the two slots, into which the frames fit. The best way to do this, is to find the centre of the shorter side of the angle, then set out a line 1 15/32 in. each side of it. Another line 3/32 in. away from this, will give you the exact position of the slots, and they will be equidistant from the ends of the beam.

Find the centre of the longer side of the angle; and on it, mark off a $\frac{1}{8}$ in. square, for the drawbar hole. At $2\frac{1}{8}$ in. from the centre of this, on each side, and on the horizontal centre-line of the angle, mark off two points, and make a heavy centre-dot on each. These are for the buffer holes. Also, centre-dot the drawbar hole. At $\frac{7}{8}$ in. from each side of the drawbar centre, scribe a vertical line down the angle, and another a full $\frac{5}{16}$ in. farther on. Next, on these two pairs of lines, make centre-dots $\frac{1}{8}$ in. from the bottom, and two more at $\frac{5}{16}$ in. above them. These are for the rivet holes. That finishes the marking-out.

Drill all the marked spots with a No. 41 drill; then open out the buffer holes with a $\frac{5}{16}$-in. drill, and the drawbar hole with $\frac{1}{8}$-in. drill. File this hole square, using a watchmaker's small square file, until a piece of $\frac{1}{8}$-in. square rod will slide into it easily. Countersink the rivet holes on the outside of the angle, with a 5/32-in. drill. Let the drill cut until the full diameter is just showing at the edge of the hole; no more.

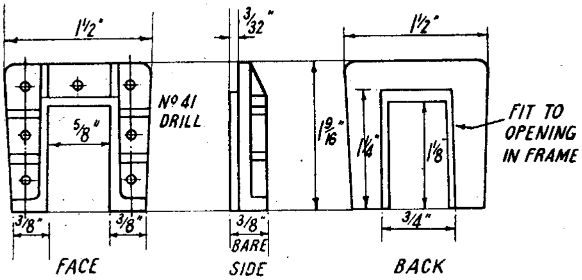
The next job is to cut the slots; and if you look up my notes about the whys and wherefores of angle buffer beams in the issue for April 28th last, you will see exactly how they can be cut truly, without the aid of machinery. However, they can be cut much more speedily, and also to "guaranteed" accuracy, if the job is done in the lathe, the process being very simple; but a milling cutter of the "circular saw" type is needed for the job. This should be 3/32 in. thick, and not less than 2 in. diameter; $2\frac{1}{2}$ in. is preferable. It is mounted either on a spindle between lathe centres, or on a short spindle held in the chuck. In the days gone by, when my equipment was limited, I got a bolt just big enough to fit the hole in the cutter, and two nuts. The head of the bolt was sawn off, and the end trimmed up, either by filing, or facing off in the lathe. One of the nuts was then run right down to the end of the thread on the headless bolt; the cutter put on, and then the other nut, which was well tightened up, to prevent the cutter shifting. The plain part of the bolt was then gripped in the three-jaw chuck, and the cutter was then all ready to operate. If the hole was big, and I had to use a fairly big bolt, both ends of it were centred in the lathe, after beheading it; and the bolt was then run between centres, being driven by a carrier clamped on to the plain part. If I had no bolt big enough to suit the cutter, I put a washer in the hole, and a suitable bolt through the hole in the washer; and another washer, larger than the hole in the cutter, was placed at each side of same, between nut and cutter, just like the way an emery wheel is mounted.

To cut the slots, the piece of angle is clamped under the slide-rest tool holder, parallel to the lathe bed. You can set the angle true in a brace of shakes, by putting the faceplate on the lathe mandrel nose, holding the stock of the try-square against it, and setting the angle to the blade. Tighten the tool clamp, and Bob's your uncle. Now, very carefully, set the marked-out slot to the edge of the cutter; run the lathe at its slowest speed, and feed the beam on to the cutter very slowly. Apply some cutting oil with a brush. I use Edgar Vaughan & Co.'s "Cutmax," diluted with half its bulk of paraffin; this gives a lovely finish, and keeps the lathe free from rust—my machines are all silvery bright. However, any good cutting compound, or even soapy water, can be used; but if using the latter, or any cutting oil which is soluble in water, be sure and give the lathe a good wipe down when the job is finished. Otherwise you will have the unpainted parts going rusty, and the painted parts will be covered by a sticky mess which clings like fish glue.

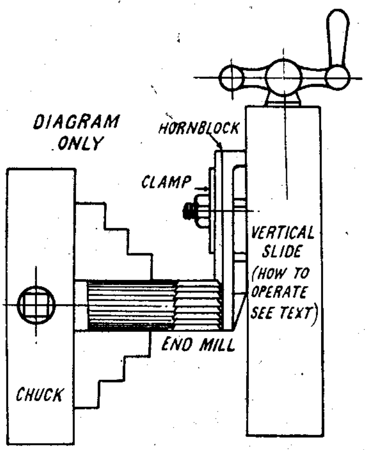
Angles for Frame Attachment

Cut four pieces of the same kind of angle used for the beams, and finish them to a length of $\frac{5}{8}$ in., with nicely squared ends. If the bits are sawn over length, they can be gripped together in the three-jaw chuck, and faced off with a round-nose tool set crosswise in the rest. It doesn't matter about them running "axially" true; as long as the jaws are in contact with the sides, the ends will be at right angles to the sides after facing off.

These pieces have to be riveted to the beams, flush with the inside edge of the frame slots; another easy job. To locate them correctly, all you have to do is to jam a piece of 3/32 in. sheet steel in the slot; put the bit of angle tightly up against it, and hold it there, either with a toolmaker's cramp or a small hand-vice; then run the No. 41 drill through it, using the holes already in the beam for a guide. Smooth any burrs off which may be left from the drilling; put 3/32 in. round-head iron rivets through (one at a time,



Hornblocks for "Tich"



How to machine hornblocks, using vertical slide

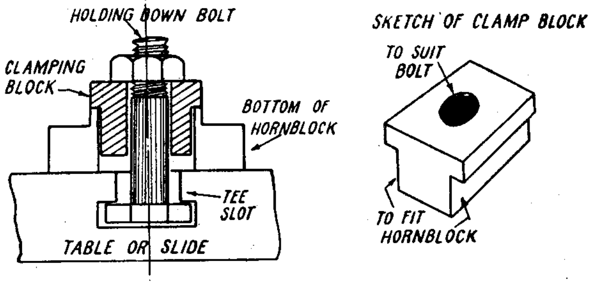
naturally !) and if they project more than 3/32 in. beyond the beam, snip off the stems to leave that amount. Then carefully hammer down the stems into the countersinks on the outside of the beam, resting the head of the rivet on top of a small piece of steel bar (any convenient size you have handy will do) held vertically in the bench vice. If you wish to preserve the shape of the rivet head, make a depression in the "dolly," or "holder-up," by drilling a countersink in it with a $\frac{3}{16}$-in. drill, placing a $\frac{3}{16}$-in. cycle ball in the depression, and giving it a few hearty cracks with a heavy hammer. This will form a cup, into which the head of the rivet will fit, whilst you commit assault and battery on the stem. When through, file off any projections on the face of the beam, and give it a final rub on a sheet of emery-cloth laid on something flat. The rivets, if steel or iron, should then be invisible.

Note.—If the builder intends to braze the frames to the beams, no angles are needed, so don't drill any rivet holes in the beams.

Hornblocks

The hornblocks for this engine are the "standard" hornblocks I specify on normal type engines for 2½-in. gauge. If the hot-pressed alloy hornblocks are procurable, they save work, all filing or milling of the contact faces being eliminated. However, some of the castings I have seen, are very nearly as clean ; one set in particular, which was sent to me many years ago by Mr. W. Bryden, of Sydney, N.S.W., I used without touching the contact faces at all. If you buy castings, and they are reasonably clean, judicious application of a file will be all that is needed to fit them to the openings in the frame. Hornblocks can easily be machined in the lathe, by the method illustrated, when a vertical slide is available. I have said before, and have no hestitation in repeating, that a vertical slide should form part of the regular equipment of every home-workshop lathe worthy of the title ; and if manufacturers concentrated more on a heavy substantial construction, with a few useful accessories, instead of a more or less flimsy machine with a lot of fallals that are seldom or never required on our job, the said machines would be far more useful, and turn out better work in less time. I might mention that something of the sort will soon be available.

To bolt the casting to the slide (or to the milling-machine table, if one is available) you need a little block of metal about ¾ in. square, and about ⅜ in. thick. This is sawn and filed, or milled, to the shape shown in the illustrations, the narrower part being an easy fit in the hornblock jaws. A hole about $\frac{5}{16}$ in. diameter is drilled through it. The head of a short $\frac{5}{16}$ in. bolt is turned down until it will slide easily in the tee-slot in the slide or table ; and the hornblock can then be clamped down to the face of the slide, or milling-machine table, as shown in



How to mount hornblocks for machining

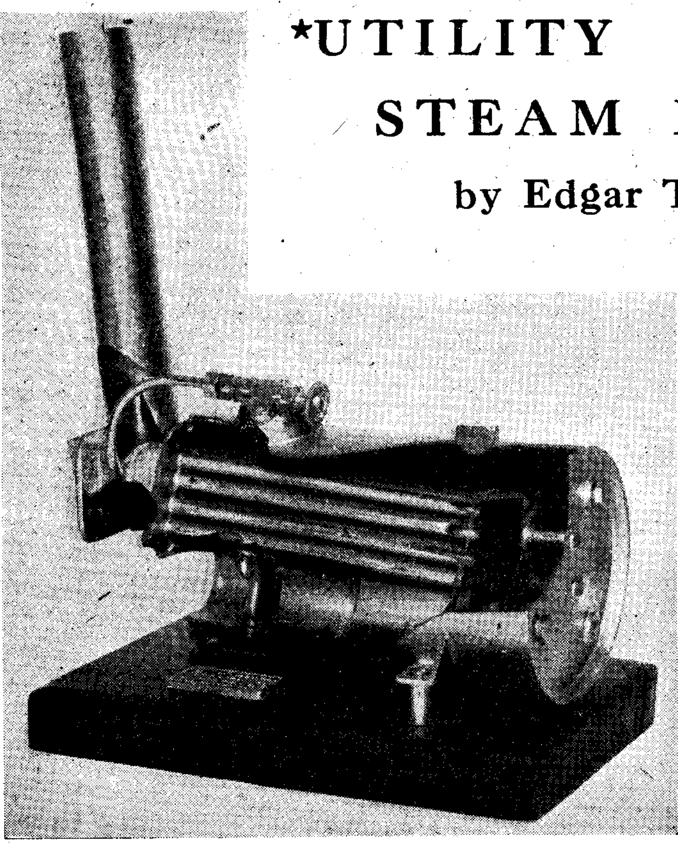
the illustration, which explains better than any words. Incidentally, I've often thought, with a smile, when looking at one of the "Dick Tracy," "Kit Conquest," or similar type of picture story strip in daily periodicals, that I could do a locomotive-building serial by a similar strip—and you'd then see what Inspector Meticulous, Ken Knowitall, Tommy Tyro, Milly Amp, and the rest of "the gang" looked like !

Once the hornblock casting is set up, with the sides of the little flange (the part that fits in the opening in the frame) at right-angles to the lathe

(*Continued on page* 110)

*UTILITY STEAM ENGINES

by Edgar T. Westbury



A sectional specimen of the return-tube Scotch boiler, by British Industrial Model Services, Ltd., Bournemouth, as shown in the drawing on page 804 *of the June* 30*th issue of* THE MODEL ENGINEER

FOR steam plants of really high power/weight ratio, whether intended purely for racing or otherwise, the flash boiler seems to be the only practical solution to the many problems in high-efficiency steam generation. Not only is the boiler light in itself, by reason of the small amount of material in relation to heating surface, but it has practically no internal capacity to speak of, and thus the weight of water it contains is negligible. Moreover, circulation problems are eliminated, as it does not rely on convection currents, and the water is forced to traverse the entire length of the generating tube or tubes, under the pressure obtained from the feed pump, or whatever other device is used for the supply of water to the boiler.

This being so, it may well be thought that there are no serious problems or difficulties in the design of flash boilers, but such an idea is fallacious, as many model engineers who have worked on this assumption have found out to their sorrow! Nevertheless, a good deal of success has been attained with flash boilers which have been " designed " purely by rule of thumb, and despite the fact that they have been very extensively used for nearly forty years in model power boats, it can hardly be said that their design has made consistent progress, or that any reliable rules for their design have been evolved. That being so, I do not propose to rush in where angels fear to tread by attempting the establishment of such rules, but to give only a brief review of the subject, based on observation of successful and also unsuccessful experiments carried out over several years.

While the obvious and most popular role of the flash boiler is for engines of the highest possible performance, and for model racing hydroplanes in particular, it should not be regarded as confined entirely to this limited field, or as unsuited to the requirements of engines which come within the " utility " classification. As a matter of fact, the notorious temperamentality of the model flash boiler arises mainly out of the extreme demands made upon it for the highest possible performance, where everything in the plant must be keyed up to concert pitch, and the slightest imperfection of any of its parts, or deviation from their correct adjustment, may mean complete failure. With slightly more modest aims in respect of power output, and greater margins in hand, the flash boiler can be as flexible, docile and trouble-free as any other type of boiler, while still being lighter and more compact for a given output. It also has the great practical advantage of being the safest type of boiler for really high pressures; problems of fabricating, sealing and staying large containers of complex structure are eliminated, mechanical margins of strength are high, and in the event of a boiler failure through too high a pressure or temperature, little damage to anything but the boiler itself is likely to occur; the disruptive effects of the sudden release of a large quantity of high-pressure water and steam are almost entirely absent.

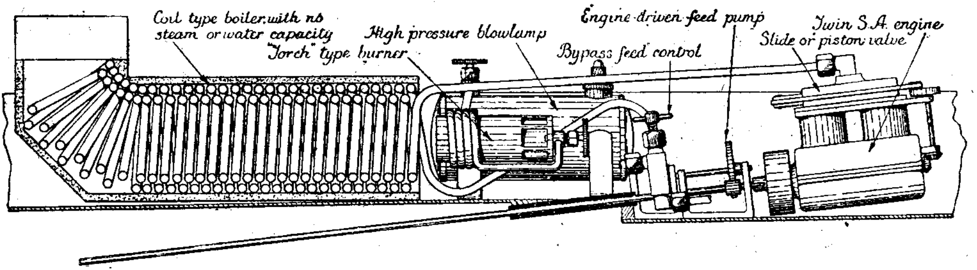
The majority of small flash boilers are made of steel tubing, mainly in order to resist high tem-

**Continued from page* 39, " *M.E.,*" *July* 14, 1949.

perature. In certain circumstances, particularly if the supply of feed water should be partially or completely stopped for any reason, the temperature of the tubing may become sufficiently high for its strength to become considerably impaired, which is much more likely if it is made of copper than of steel. But even below such dangerous temperature, copper is liable to scale badly, and rapid wastage is caused, while the scale is liable to do a great deal of harm to the engine.

these to admit air for assisting complete combustion, others to release the products of combustion, others again don't know quite why—but the result is much the same in impairing thermal efficiency.

There is no agreement among designers in the diameter or length of tubing required to generate steam for a given size of engine. It is generally agreed that a small diameter of tubing is desirable for efficient heat transmission, as the water is kept in intimate contact with the tube walls,



A popular form of flash steam plant as employed in model speed boats, using a two-layer coil boiler, fired by a torch blowlamp

If, however, the temperature of the boiler can be kept within reasonable limits under all conditions, copper tubing can safely be used, and has proved quite successful in several boilers fitted to non-racing model power boats, being much easier to bend than steel, and having higher thermal conductivity. Steel tubing does not usually give much trouble in respect of internal corrosion, the major wastage being on the outside through heat oxidisation and scaling, in all cases that have been under personal observation. The use of stainless-steel tubing is an obvious idea for avoiding both corrosion and heat wastage, but it is easier said than done, especially under present conditions, when one is lucky to be able to obtain any kind of tubing at all, without enquiring too closely into its quality or metallurgy.

Most small flash boilers have been constructed in the form of circular coils of tubing, mainly because of the difficulty of bending tubes into anything but fairly easy circular curves, though there are potential advantages to be obtained by exploiting boilers of other shapes. The circular "tunnel" boiler composed of one or more concentric coil layers is not only easy to make, but it also suits the requirements of the most popular form of liquid fuel burner, which is almost universally employed for firing such boilers. Several years ago I pointed out the advantages of boilers having looped grids, "clock spring" spirals, and "figure 8" coils, but the difficulty of shaping them deterred experimenters from trying them out, and as they called for the use of different types of fuel burners, this also detracted from their popularity.

The casing of a flash boiler should logically be well lagged internally to conserve all the heat possible, but although it is usual to fit an asbestos millboard lining, its effect is often cancelled out, because, owing to combustion difficulties with the burner employed, it becomes necessary to ventilate the casing by means of louvres throughout its entire length. Some experimenters use

more so than in a larger tube, where it can pass down the centre, leaving the walls partially insulated by the formation of steam bubbles. A fairly high velocity of water through the tube facilitates rapid heat transfer, but on the other hand, increases skin friction, so that there may be a loss of effective steam pressure Some designers have favoured the use of tubing as small as $\frac{3}{16}$ in. diameter for a normal model power boat plant, while others have used $\frac{5}{16}$ in. or even $\frac{3}{8}$ in. diameter tube. The use of two diameters of tube, the smaller at the entry end, and the larger at the discharge end, to conform with the change in volume from water to steam, is not uncommon.

Lengths of tubing as great as 60 ft. or 70 ft. total have been used for steaming a twin single-acting engine $\frac{3}{4}$ in. $\times$ $\frac{3}{4}$ in., while at the other extreme, there is an example of an engine of this size performing efficiently on a boiler having only 10 ft. of tubing. For the "Spartan" engine or one of comparable size ($\frac{3}{4}$ in. $\times$ $\frac{3}{4}$ in. single-cylinder, single-acting) 20 ft. of $\frac{1}{4}$-in. tubing will give good results, though it is not claimed that this figure could be improved upon. To improve the heat-conducting efficiency of boiler tubing, the method employed by Serpollet, of crimping the tube, to produce alternate depressions at right-angles to each other, has definite possibilities, but here again, there are difficulties in carrying it out.

One of the greatest practical problems in flash steam generation is to adjust the rate of feed supply to conform exactly with the requirements of the engine, so as to maintain the required working pressure, with a moderate superheat, and avoid the risk of either the boiler itself or the steam within it from attaining an undesirably high temperature The feed pump is quite literally the heart of a flash steam plant; like the human heart, it has but to miss a single beat to cause trouble, and any serious derangement in its function is fatal. For this reason, complete reliability of the pump is most essential, and its

design is as important as that of the engine itself. Some means of adjusting the amount of water delivered by the pump is generally essential, but up to the present, nobody, so far as I am aware, has seriously tackled the problem of making this adjustment automatic, though it is by no means impossible to do so by using a thermostatic control.

Should the feed pump go completely out of action for any reason, there is always a risk of damaging or completely destroying the boiler by excess heat. This applies in cases where the engine of the flash plant stops when out of range of the operator, a very common eventuality in the running of model power boats, and is very often an argument against using flash plant in any boats other than those purely intended for racing purposes. Several devices have been contrived to protect the boiler in the case of an engine stoppage. One of the most ingenious, by Mr. H. J. Turpin, consisted of a hydrostatic valve in the feed pump delivery line which, in the event of a complete drop of feed pressure, would release the air pressure in the blowlamp container and thereby extinguish the lamp.

Within recent years, however, several experimenters have used blowlamps which do not rely on air pressure, but are directly fed with fuel from a mechanical pump driven by the same gearing as the feed pump. This not only provides some definite measure of co-ordination between the rate of feed water supply and the heat supplied by the blowlamp, but also makes a safety device unnecessary, as stoppage of the engine also stops both the feed pump and the fuel feed to the blowlamp.

In a series of articles published in THE MODEL ENGINEER before the war, I gave several suggestions for the improvement of the design of flash boilers and their accessories, some of which have been acted upon by readers with a varying amount of success. There is, however, still a very wide scope for improved design in the steam generating components of flash steam plants, quite apart from the engine itself.

As a matter of fact, I think that many experimenters who have attempted to improve or elaborate the engine design have been tackling the problem from the wrong end, because although such engines may be potentially capable of producing increased power, they have produced little or no improvement in the overall power output of the plant, due to the limitations in the efficiency of the burner or the boiler.

It has been found in many cases that the simplest types of steam engines give the best results in flash steam plants, provided that they are capable of standing up to the increased temperature pressure and mechanical stress, because their mechanical efficiency is better than engines having highly elaborate valve-gears or similar complication.

(*To be continued*)

"L.B.S.C."

(*Continued from page* 107)

centre-line, the job is easy. To set the hornblock right, simply put the stock of your try-square on the lathe saddle, and set one side of the flange to the blade; then tighten the bolt. See that the sides of the holding-down block do not project beyond the flange. Now put an end-mill, or a slot drill, not less than ⅝ in. diameter, in the three-jaw, as shown. Feed the hornblock casting on to it, by the aid of the saddle screw or top slide screw; then, by careful manipulation of the handles of the cross slide and the vertical slide, you can traverse the casting up, down, and across the cutter, which should revolve at a good speed. The cutter will clean up the contact faces, and leave a nice sharp corner between contact face and side of flange, which will fit snugly into the opening in the frame. I do this job on my vertical milling machine, which is exactly the same process "turned sideways" as the kiddies would say; the cutter operates vertically, and the slide horizontally, the slide being the miller table, which is operated by the two handles (longitudinal and cross feeds) to let the cutter cover the whole of the contact face. I use a piece of metal, with an opening in it exactly the same as those in the frames, as a gauge; you can do the same.

Drill seven No. 41 holes in each hornblock, as shown in the illustration; then fit one to the frame. Hold it in position with a toolmaker's cramp; this can be home-made, from a couple of pieces of ½-in. square bar and a couple of ¼-in. screws. Run the drill through all the holes, carrying on right through the frame. Countersink the holes outside frame, and rivet the hornblock in place, as described for the buffer beam angles. A dolly, in which to rest the rivet heads whilst hammering down the shanks, can be made from a bit of ½-in. square rod about 4 in. long. Turn one end to a blunt cone, leaving the end about $\frac{3}{16}$ in. across; make a cup-shaped depression in the end, as described above, with a $\frac{3}{16}$-in. drill and cycle ball, and put it vertically in the bench vice. After riveting in the hornblocks, file off any projections, flush with outside of frames. That will be enough to go on with, and next stage will be frame erection.

Improvements and Innovations

No. 3—Safe Driving

by "1121"

WE intimated in "Dangerous Driving!" that the Society of Model and Experimental Engineers had been receiving suggestions for some sort of scheme by means of which the superintendent of a passenger-carrying track operating in public could be assured that any strangers or partial strangers, turning up to assist with the driving, were fit people to be entrusted with this responsible duty. As some of these suggestions had come from societies affiliated to the S.M.E.E., it was decided to let the Affiliation Committee prepare the scheme, and the system with which this article deals has been evolved as a result.

Briefly, the idea is to award certificates to people whom it is considered are sufficiently experienced and reliable to drive virtually any engine under the most arduous pressure of public traffic with safety and efficiency, with the objects of safeguarding (*a*) engines on loan to the club doing the driving, (*b*) engines going away to be driven elsewhere, and (*c*) the general public.

A Different Job

We would like to remind readers that pottering up and down one's own bit of track, with one's own engine, and one's own pals as passengers, is a very different kettle of fish to the business of working heavy trains of ebullient youngsters under the possible eagle eye of an L.C.C. or other inspector. For, make no mistake about it, the loco fraternity as a whole, and certain clubs in particular, have had a generous share of luck in the matter of accidents in the past. At a recent meeting of the S.M.E.E. the scheme here being described was thrown to the members for criticism, and one legal gentleman present expressed the view that many of the accidents which have occurred in the past, and many of those that will undoubtedly occur in the future, *could* have very serious consequences. The repercussions of these consequences might be, at best, the handing over of this sort of traffic exclusively to professional outfits, and at worst a banning of the operation of model steam locomotives in public altogether. This was not just pessimism, the speaker assured us, for already a considerable number of influential officials regarded our engines as providing about the same degree of safety as a high-explosive bomb. We wonder, in passing, just how many clubs carry out, or even know about, the Board of Trade's regulations appertaining to the operation of steam boilers, of any size, in public?

To get back to the main subject—a rough scheme has been evolved, but is still in many ways in an undeveloped state, and as so many people may be affected by it quite outside and unknown to the body entrusted with its preparation, that body wishes to be quite sure that, whatever details are finally arranged, they will cover all requirements as completely as possible and with the greatest degree of fairness and usefulness.

What's Your Opinion?

This preliminary article is therefore being offered for consideration with the purpose of inviting—more, begging for—criticisms, advice, points of view, and any other observations calculated to improve the working of the scheme. We wish to point out from the first, however, that we are not interested in and shall ignore the views of those folk, which any idea of any sort is bound to bring to the surface, who distrust anything new merely because it *is* new; or because they immediately suggest that somebody, or some "clique," is trying either to make something out of it, or to become a little tin god and rule the roost, if we may be excused the mixed metaphor. For the guidance of any such folk reading this we wish to stress as emphatically as possible the following four points:—

(1) The idea for the scheme came originally from no one particular society. It appeared quite independently from several sources, mostly quite unrelated, and was handed over independently by those sources to a committee which represents some, but not all, of those sources, namely the Committee of the S.M.E.E. Affiliation.

(2) The operation of the scheme will in no way impose restrictions or other hardship on any society or individual; no attempt is contemplated to tie anybody down to its observance. The idea is merely to provide a "safety-catch" which any society can apply with confidence should it feel the need, although we hope that our expression will not be taken to infer that any other kind of "catch" is involved!

(3) Nobody wishing to make use of the system, either to apply it or to have it applied to him, will be barred from doing so. In other words, any club, affiliated or otherwise, or, for that matter, any other body or individual running a passenger-carrying railway, will be welcome to make use of the protection the scheme is designed to provide; and similarly, any club member, or independent individual, will be eligible for qualification as a certificated driver.

(4) In evolving the scheme the utmost care is being taken to ensure that no personal favouritism or prejudice can possibly have any influence on the qualification of drivers.

The last item mentioned above is that with which we are most concerned when we say that the Committee has not yet made final arrangements for the detailed operation of the system, and wish the scheme in its present embryo form to be given the widest possible publicity, so that

all those interested may have an opportunity of submitting their views and suggestions as to its failings and possible improvement. It will be appreciated that a scheme of this sort can hardly be altered in any fundamental respect, once it has been got under way, without producing complaints of unfairness either from those already in it, or those wishing to be in it, or both. And so we propose, having outlined the preliminary idea, to wait a reasonable time for the reaction, and then to publicise the details of the finished article evolved as a result.

As far as it has been worked out then, the plan will operate somewhat as follows :—

A candidate will be awarded a preliminary certificate, possibly from within his club if he is a club member, which merely states that he has had some experience of driving locomotives, and is therefore at least on the way to becoming fitted to handle public traffic. This constitutes his passport to the second stage—application for the Second Certificate, which confers on him the status of first-rate driver, who can be trusted to handle locomotives in general with complete reliability.

The proposal at the moment is that there should be a panel of well-known personalities, chosen mainly for their integrity and reputations for fairmindedness rather than exhaustive technical knowledge of locomotives or track-working as a whole. This panel would be provided with a list of rules, pointers, advice and such like, the contents of which would be made public, which they would be asked to use as guidance in the process of sifting the applications for Second Certificates.

It is suggested that each applicant should be allocated a number at some early stage in the proceedings, possibly a serial number on his First Certificate, which number would remain his sole identity when his application for the Second Certificate came before the judging panel, and in any future dealings with them. The judges thus would not know the names of the people under consideration, but only the qualifications associated with each number. These qualifications would be gleaned from any and every available source, and it would be up to the applicant to provide whatever reference he could to further his case. Should the applicant feel that his facilities in this respect are insufficient to do him justice, or should the judging panel desire further information, they or the applicant could request that he should submit to a test on a track, and possibly a simple questioning on procedure in emergencies.

Examination

This examination would be carried out by people chosen either by the Affiliation Committee or by the judging panel, for their experience, and their convenience geographically. Their observations resulting from the test could then be supplied to the judges to add to their original information. This would probably mean, in actual fact, that practically every applicant not known personally to some responsible member of the organisation would need to be tested; and, in fact, all those with whom we have discussed the question, including well-known people in the model loco world, appear to prefer that they should gain their certificates through a test of this sort rather than merely through the recommendations of others.

All this, of course, opens up untold difficulties which will have to be solved before the scheme can be made to work to its full capacity. Would-be drivers cannot all be expected to converge on London or any other centre for their examination, and we appeal to any clubs or other owners of tracks to assist in this matter. Several societies and individuals have already placed their tracks and locos at our disposal, but these are all in the London vicinity, while to cover all possible requirements it will be necessary for testing-grounds to be available all over the country.

Similarly with examiners, it is doubtful whether many sufficiently-experienced people could be found to travel over the length and breadth of the country visiting every model engineering community as required; even were there any machinery for the payment of their bare expenses, nothing has yet been said or decided about the question of charging for these certificates, to offset the cost of running a system of such magnitude as this threatens to become. And there are certainly very few people who could spare the time for all this running about, even if paid to do it. We mention all this to indicate that we are not unaware of the problems involved, and there is no need for the more pessimistic section of the model engineering fraternity to write in and enumerate them; what we want is help in getting over them!

Questions and Answers

At the S.M.E.E. meeting mentioned earlier, some apprehension was expressed as to the form any verbal questioning might take, it being pointed out that a person unused to having awkward questions shot at him is liable to develop a form of stage-fright and become flummoxed at a simple question, the answer to which he would give perfectly well in less disturbing surroundings. We will answer this objection in two ways; first, by saying that examiners would use reasonable tact to avoid taking unwarranted advantage of a nervous candidate; and secondly, by observing that a sudden emergency is likely to give rise to a far worse attack of "jitters" in such a candidate than a quiet question from a competent examiner. We have in mind two or three candidates driving round a continuous track for an hour or so with no interference from the examiners except an unobtrusive observation of their actions. An "emergency" is then created by an examiner informing a driver that his gauge-glass has cracked. The driver concerned is then expected to pull-up, making sure that anyone following closely behind is aware of this action, and then to carry out whatever measures he thinks necessary to deal with this emergency. In the case of some emergencies, of course, he would not be able to reproduce the necessary actions, but would be asked to describe them. Should the emergency be of such a nature that he is unable to give any warning of a sudden stop to the following train, and that train shows signs of

(*Continued on page 117*)

A Locomotive Running Stand

by W. M. Shellshear (Australia)

IN writing on this subject, I feel that some explanation is necessary in view of the many fine articles which have already been published on the same subject. However, as the running stand to be described was designed primarily for the benefit of those operators of little locomotives who, like myself, are unable to put down a track, I feel some justification in putting forward what I venture to suggest may appeal to some as a more scientific approach to the problem of reproducing actual running conditions on a stationary stand.

I think it will be generally agreed that a locomotive running stand, to be of any great value, should fulfil three requirements :—

(a) It must provide the means of controlling the building up of speed when the throttle is opened, so that the rate of acceleration of the mechanism cannot exceed the rate which would be observed in track running.

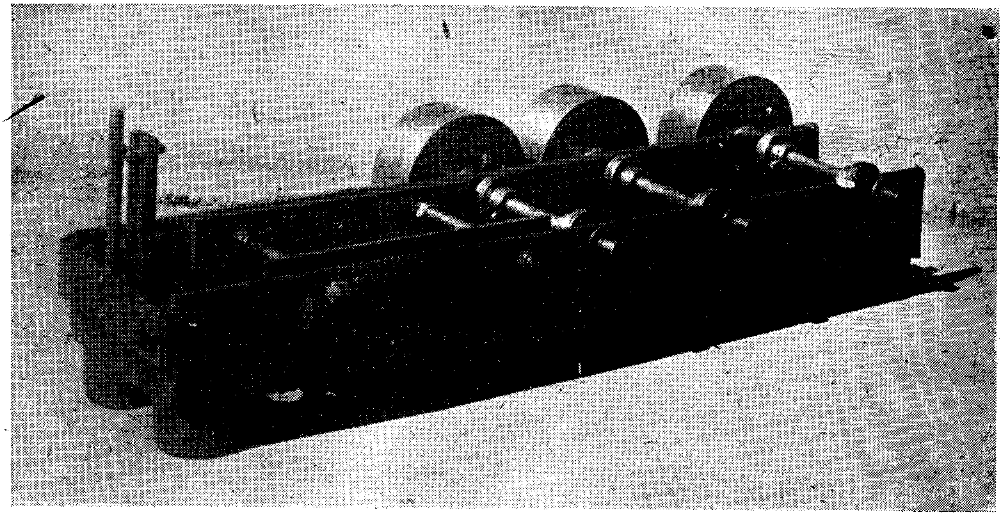
(b) It must provide a reservoir of stored energy so that, when the throttle is closed suddenly, the mechanism will not come to a sudden stop but will gradually decelerate or " coast " to a stop.

(c) It must permit of slow running.

In addition, means should be provided for registering the drawbar effort being developed at any stage of the test run.

With the exception of the stand to be described, I have yet to see the first three very desirable features incorporated in a locomotive test stand.

For simplicity of construction (my stand took less than a fortnight of spare time to build), it is suggested that the stand be designed to suit the builder's particular locomotive, although it would not require much ingenuity to make it adjustable as regards roller centres, counterweights, etc., for use as a club stand. The following description will, therefore, be based on a given requirement as regards which centres and locomotive weight.

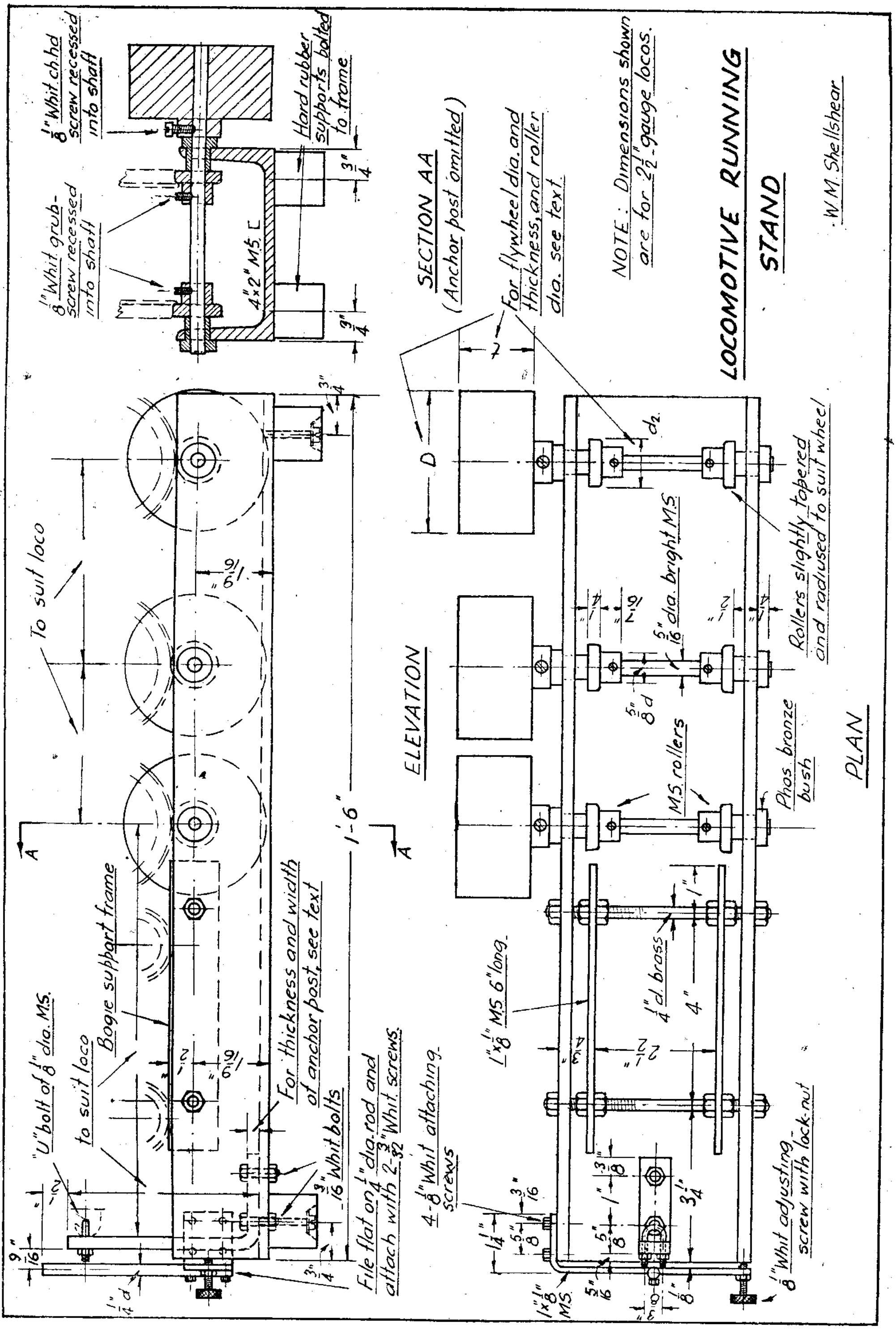


The locomotive running stand for models

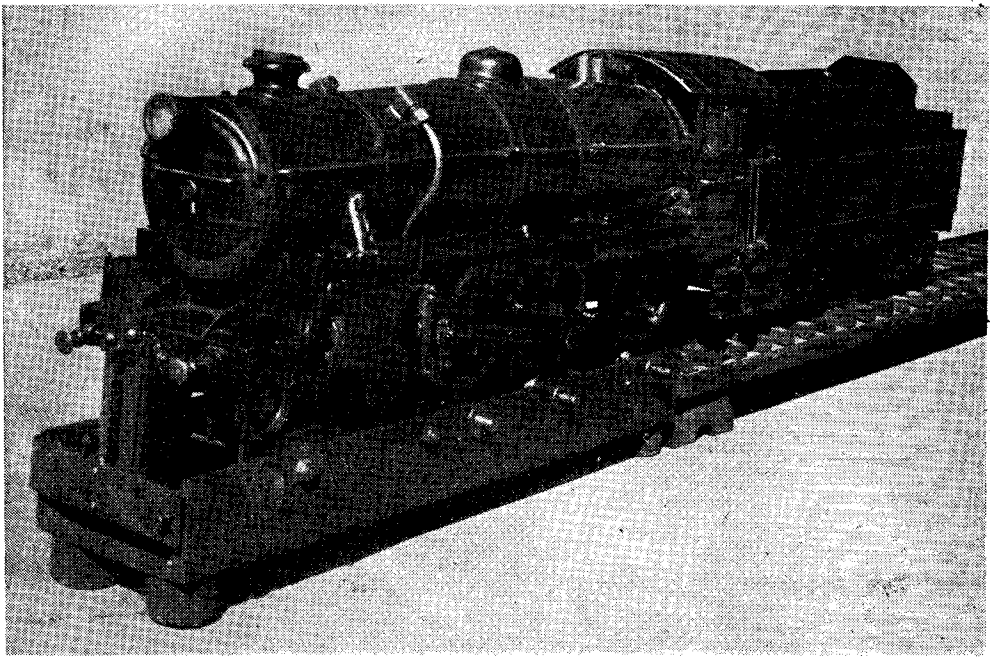
A glance at the appended diagrams will show that the body of the stand need only be long enough to accommodate the engine ; the tender, as the accompanying photograph indicates, remains on its own stand, or any suitable platform for that matter, packed up to correct height in relation to the locomotive stand.

The body of the stand is a short piece of structure steel channel section (4 in. × 2 in. is ideal for 2½-in. gauge) raised up off the ground by four small hard rubber " door stops " as sold by the local chain stores for about three-halfpence each. The sizes shown are those I used for my 2½-in. gauge 4-6-0 locomotive shown in the illustration.

It will be noted that each roller axle is extended through the frame at one side and carries an independent flywheel. This is preferable to the use of a single large flywheel with coupled axles as it avoids possible troubles in maintaining a positive backlash-free coupling. Construction as shown is simple anyhow !


LOCOMOTIVE RUNNING STAND
W.M. Shellshear
NOTE: Dimensions shown are for 2½" gauge locos.
SECTION AA
(Anchor post omitted)
1/8" Whit. ch. hd. screw recessed into shaft
1/8" Whit. grub-screw recessed into shaft
Hard rubber supports bolted to frame
4"×2" M.S. ⊏
For flywheel dia. and thickness, and roller dia. see text.
ELEVATION
PLAN
To suit loco
"U" bolt of 1/8" dia. M.S.
to suit loco
Bogie support frame
For thickness and width of anchor post, see text
9/16" Whit. bolts
File flat on 1/4" dia. rod and attach with 2-3/32" Whit. screws
4-1/8" Whit. attaching screws
1"×1/8" M.S. 6" long
1/4" d. brass
5/16" dia. bright M.S.
M.S. rollers
Phos. bronze bush
Rollers slightly tapered and radiused to suit wheel
1/8" Whit. adjusting-screw with lock-nut
1'-6"
1"×1/8" M.S.

The rollers used are small in diameter compared with the engine wheel, in order to give the necessary speed of rotation to the flywheels; and it will be obvious that each roller axle assembly must spin very freely in its bearings. For this reason, phosphor-bronze bearings were used. These were turned to a very tight fit in the channel-iron body, drilled to neat size and then driven in. The holes, which close in slightly during this operation, then permit the use of a reamer pressed through both bearings at the one operation whereby perfect alignment is assured.



The stand with a model locomotive in position

It should be added that there is no difficulty whatever with adhesion between the driving wheels of the locomotive and since a small roller; my engine will resist all attempts to make it slip, even when the roller surfaces become slightly greasy, as often happens.

Constructional details should be clear from the drawing. The flywheels of the pilot model were turned out of standard mild-steel shafting which the local steel merchants will saw into convenient lengths for a small charge. As an alternative, of course, iron castings may be used.

The anchor post should be so located that when the front coupling is pulled tight up against it by means of the U-bolt provided the driving wheel centres are directly above the roller centres. The function of the indicator post will be described later.

Calculation of Roller and Flywheel Sizes

The basis of the following calculations is that the energy stored in the flywheels, when rotating at a speed corresponding with a given engine speed, must equal the energy which would be stored in the locomotive itself were it moving at that speed on a track.

Now the energy stored in each flywheel $= \dfrac{Wv^2}{2g}$ foot-lb.,

where W = weight of each flywheel in lb.
v = the velocity measured at the mean radius of gyration of the flywheel (see below) in ft. per second.
g = 32.2 ft. per second per second.

If there are N flywheels, the total energy stored in the system $= \dfrac{NWv^2}{2g}$

Also, $W = \dfrac{\pi D^2 t}{14.12}$ lb. for M.S. (or $\dfrac{\pi D^2 t}{15.2}$ for C.I.) flywheels

where D = flywheel dia. in inches
t = „ thickness „
and mean radius of gyration $= \dfrac{D}{2\sqrt{2}}$

Let it be assumed that the engine is moving at a speed corresponding with one turn of the driving wheels per second. Then, if the driving wheel diameter is d_1 in., and the roller diameter d_2 in., then for one turn per second of the drivers, the roller shaft will rotate at $\dfrac{d_1}{d_2}$ turns per second, and a point at the mean radius of gyration of the flywheel will move at a velocity of

$$2\pi \times \frac{D}{2\sqrt{2}} \times \frac{d_1}{d_2} \text{ inches per sec.}$$

$$= \frac{\pi D d_1}{12\sqrt{2d_2}} \text{ feet per sec.}$$

then v in the above formula will equal $\left(\frac{\pi D d_1}{12\sqrt{2d_2}}\right)^2$

Total energy stored in flywheels ∴ equals

$$N \times \frac{\pi D^2 t}{14.12} \times \left(\frac{\pi D d_1}{12\sqrt{2d_2}}\right)^2 \times \frac{1}{64.4} \text{ foot lb.}$$

(for M.S. flywheels)

Similarly the energy stored in a locomotive and tender of total loaded wt. W, lb., moving at a speed corresponding with one turn of the drivers per second.

$= \frac{W_1 v_1^2}{2g}$ where v_1 = velocity of engine in ft. per sec. corresponding with one turn of the drivers per second $\left(= \frac{\pi d_1}{12} \text{ feet per sec.}\right)$

$$\therefore \text{ energy } = \frac{W_1 \pi d_1^2}{144 \times 2g}$$

Equating these two forms of energy

$$\frac{W_1 (\pi d_1)^2}{12_2 \times 64.4} = N \times \frac{\pi D^2 t}{14.12} \times \left(\frac{\pi D d_1}{12\sqrt{2d_2}}\right)^2 \times \frac{1}{64.4}$$

or simplifying, $W_1 = \frac{N \pi D^4 t}{28.24 \; d_2^2}$

or $t = \frac{28.24 W \; d_2^2}{N \pi O^4} = \frac{9 W_1 \; d_2^2}{N D^4}$ for M.S. flywheels

(or $\frac{9.7 W_1 \; d_2^2}{N D^4}$ for C.I. flywheels).

Knowing the wt. of the locomotive and tender in running order, W_1, the diameter and thickness of the flywheels and the diameter of the roller d_2, now remain to be determined to satisfy this equation. A glance at the drawing will show that the spacing of the rollers will limit the diameter of the flywheel, D, to say ⅛ in. less than the shortest driving wheel axle centre distance. The diameter of the roller, d_2, might be taken as 1/3 of the driving wheel diameter. By substituting these values of W, D and d_2 in the above equation the required thickness of the flywheel (t) may be calculated.

If these instructions are followed carefully, the locomotive will behave on the stand exactly as though it were running on a level track and, moreover, will run at normal slow speeds if desired.

Most so-called test stands permit of two speeds only, fast or stop, due to the almost complete lack of momentum in the roller system.

So much then for requirements a, b and c.

The measurement of drawbar effort is a relatively simple matter when it is realised that drawbar (or tractive) effort is in effect, equal to the thrust of the engine against the front anchor post (always assuming that care has been taken that the driving wheel centres are directly above the roller centres).

The dimensions of the anchor post were so chosen that a horizontal thrust of 1 lb. on the post at the point of contact with the locomotive coupling caused a forward deflection of the anchor post of one-thousandth of an inch at a point approximately ¼ in. above the U-bolt.

This was done for two reasons:

(i) The average 2½-in. gauge locomotive does not develop more than about 8 to 12 lb. drawbar effort, and

(ii) The "Unique" type dial test indicator provides an accurate and simple means of measuring deflections of the anchor post of up to 0.015 in. The graduations on the indicator may then be interpreted as lb. of drawbar effort.

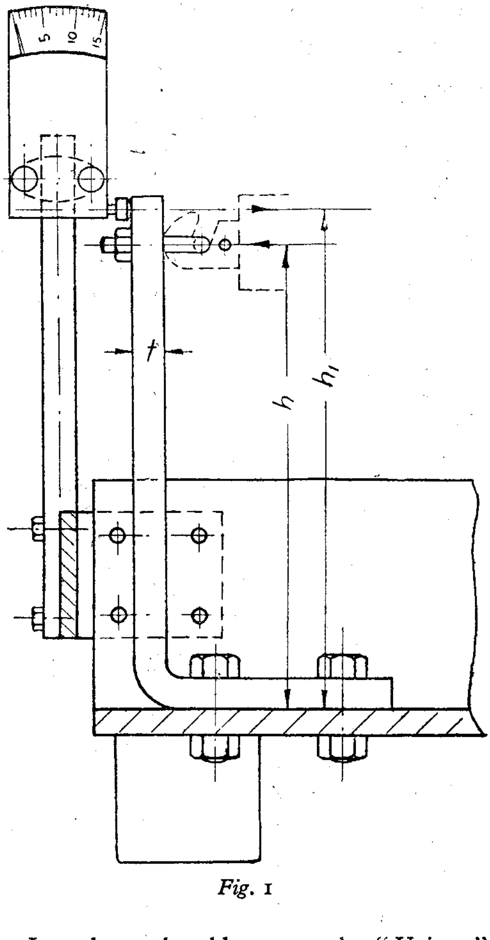


Fig. 1

In order to be able to use the "Unique" indicator for larger engines it is suggested that a stiffer post deflecting 0.0005 in. or less for each lb. thrust be adopted and the dial readings interpreted accordingly.

The following formula provides a sufficiently accurate means of calculating the thickness and width of the anchor post required:—

$\frac{h_1 h^2}{7500 X} w \times t^3$ where h^1, h, w and t are as shown in Fig. 1, and are in inches,

X = number of thousandths of an inch deflection required per 1 lb. thrust on post (X for $2\frac{1}{2}$ in. gauge locomotive, for example, would equal 1).

To simplify, if we take thickness of post equal to half the width,

$$\frac{h_1 h^2}{7500\ 1X} = \frac{w^4}{8} \text{ or } \frac{h_1 h^2}{938} = w^4$$

The indicator post to the top of which the "Unique" indicator is clamped, is a piece of $\frac{1}{4}$-in. diameter mild-steel rod, bolted to a piece of 1-in. × $\frac{1}{8}$ in. mild-steel flat rigidly bolted to the side of the channel-iron at one side and provided with a screw zero adjustment at the other side. The manner in which this makes possible a micro-adjustment on the distance between indicator post and the anchor post will be clear from the drawing. This is necessary in setting up the indicator so that, with the engine at rest, the indicator will read zero and yet be in positive contact with the anchor post.

In practice, this method of registering drawbar effort is, if anything, too accurate, as the needle of the indicator responds to each thrust on the pistons giving four distinct movements for each revolution of the driving wheels. As can be imagined, the needle sets up a merry dance as the engine speed is increased. However, it is quite feasible to note the peak readings, and if a high speed movie camera were available, some very interesting thrust diagrams could be obtained.

Finally, I suggest that in a stand of this type, the anchor post be calculated and located on the front of the frame first of all. Then measure the distance from the front face of the front coupling to the leading driving wheel centre and set off this distance from the rear edge of the anchor post to find the position of the leading roller axle centre. The rest follows from the drawing.

In conclusion, it may be stated that, from the point of view of testing and observing the functioning of the several components of the engine's mechanism, the running stand has many points in its favour over track running, and a locomotive under steam on such a stand is always a centre of attraction at an exhibition. For this reason, the flywheels have been shown located on one side of the frame only, although there is no reason why half the weight of each flywheel should not be located on each side of the frame, if the builder so desires.

Safe Driving

(*Continued from page* 112)

running into him, and its driver's attention has to be drawn to the obstruction, the examiner will no doubt feel justified in awarding him a black mark for his lack of observation of the state of the road. From considerable experience of running on continuous tracks we can assure readers that this lack of vigilance is of regrettably frequent occurrence. We have seen many a driver who, on being shouted at to stop, looked up in bewilderment at the train in front of him where he thought there was nothing but clear track, became petrified with horror and was quite unable to do anything at all about pulling up, although there would have been ample time do to so had he been prepared and acted at once.

To sum up from all this, it is the man's reaction to emergency that we are most interested in, second only to his general behaviour to avoid, or at least minimise the effects of such emergency, wherever possible. In exhibition work it is surprising the number of silly things that *can* happen; children become notoriously top-heavy when they all lean over to the same side in an effort to see the engine, and the track dead-end is capable of bobbing up in a most alarming fashion should the driver allow his attention to wander for only a few seconds. Add to all this the unfortunate fact that on some tracks, particularly those at ground-level in public places, one has to contend with *deliberate* sabotage by the contribution of sticks and stones to the track by the more experimentally-minded of the assembled spectators, and it will be realised that the question of constant vigilance by drivers is of the utmost importance.

As far as the avoidance of emergency is concerned, a number of mishaps have been due to lack of care in more technical matters, such as coupling engines to trains and coupling engines and tenders together when commencing work, and the preliminary testing of brakes, injectors, safety-valves, etc. A driver's attention to such matters when starting a new engine, or taking one over from someone else, would be likely to come in for some attention from an examiner, and it is conceivable that the happy-go-lucky attitude of many people to these matters might easily provide plenty of emergencies for the examiner to work on without his having to produce them artificially.

We hope that we have said sufficient to justify the proposals we have put before readers, and assure them that all those at present concerned with the plan are doing their best to see that it will be of the greatest possible usefulness, and we will conclude these preliminary notes by expressing the hope that our efforts will achieve a substantial reduction in the risks so often run by allowing inexperienced people to undertake this considerable responsibility to each other and the public.

IN THE WORKSHOP

by "Duplex"

*42—Gear-cutting in the Lathe

BOTH the operation described for relieving the front edges of the cutter teeth and the succeeding operation for relieving the flanks of the teeth will be faciliated, and the possibilities of error reduced, if an adjustable form of stop is fitted to the lathe cross-slide to control its inward movement in a positive manner.

An easily made and fitted stop, for use with the Drummond type lathe, is illustrated in Figs. 32 and 33, which shows the stop in position and also its component parts. Here, the base (A) of the attachment is secured in place by the ⅜-in. Whitworth bolt (B) inserted in one of the threaded holes normally used for clamping the travelling steady in position. The actual stop (C) slides on the threaded spindle (D), and is locked in position by tightening its clamp-bolt. To afford a means of fine adjustment, and to give greater security, a locking collar (E), threaded 40 t.p.i., is fitted to the threaded spindle.

There is usually no difficulty in fitting an adjustable stop of this type to lathe saddles of other patterns, but as an alternative, it may sometimes be found simpler to fit to the keep-plate of the cross-slide a fine-thread stop-screw, which impinges on the front face of the saddle and thus controls the movement of the slide.

It is advisable, when fittings stops, to position them as close as possible to the feed screw concerned in order to overcome any tendency for the slide to tilt, but the attachment illustrated has been fitted to one side to make room for the automatic cross-feed device which is normally kept in position ready for use.

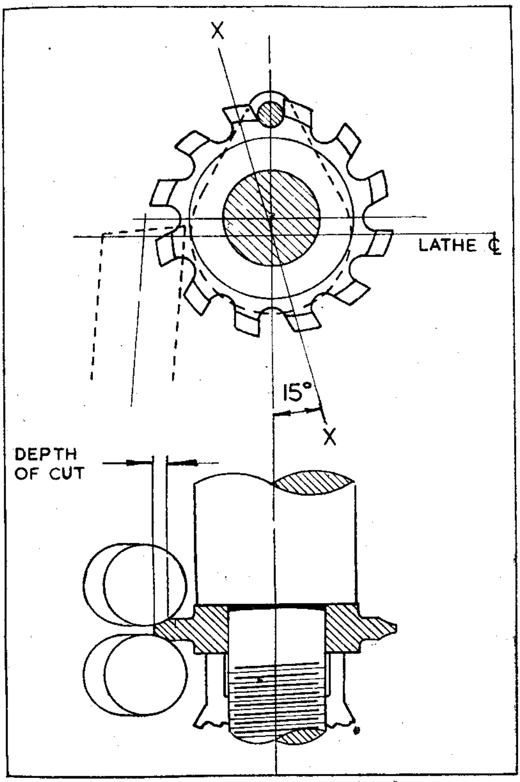


Fig. 31. View showing mounting of cutter and relation to forming pins. Note axis XX coincides with axis XX in linkage view

In passing, it may be noted that Fig. 31 shows the method adopted for the end-location of the cross-slide gib strip; in addition, the hexagon-headed screws for locking the top slide, and the lever locking-screws for the saddle can also be seen.

The next operation, illustrated in Figs. 29 (G) and 31, is, with the aid of the form tool, to relieve the flanks of each tooth in turn. Reference to Table A will show that, for the cutter under consideration, the diameter of the cutter pins fitted to the tool is $\frac{10.26}{40}$ which equals 0.2565 in., and the centre distance between the pins is $\frac{11.03}{40}$ or 0.2757 in.

Set the form tool with its cutting edges at centre height, and bring it up to the cutter blank, as shown in Fig. 29 (H), so that the pins make contact equally with the corners of the blank at the level of the tooth's flat, radial face. Then set the cross slide index to zero and lock it in that position.

Before the actual machining is begun, it is essential to lock both the saddle and the top slide to prevent any traversing movement during the shaping of the cutter teeth; this leaves the cross-slide alone free and able to move in the direction required for the relieving operation. Start the lathe and feed in the form tool carefully so that it takes a small cut each time the work rocks forwards. Again, as shown in Table A, the amount of this in-feed (E) is equal to $\frac{2.88}{40}$ that is 0.072 in.

If an adjustable stop is fitted to the cross-slide, it should be set by means of the feed screw index

*Continued from page 59, "M.E.," July 14, 1949.

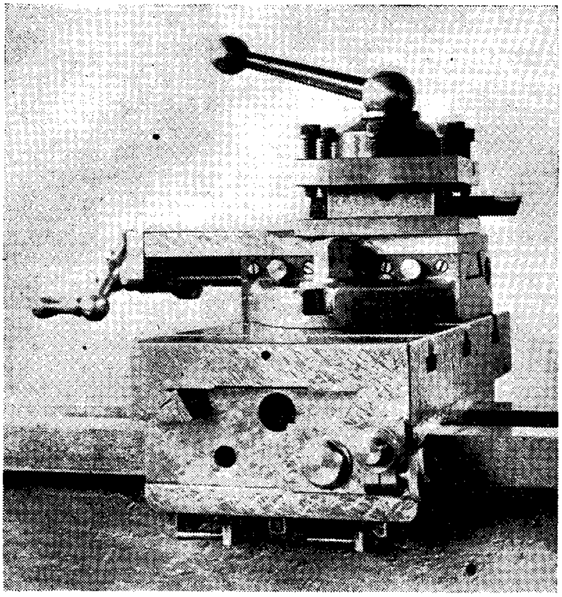


Fig. 32. *Back of the cross-slide, showing stop in position*

to limit the feed-in to this figure. Thereafter, when machining the remaining cutter teeth, the cross-slide is fed up to the stop and the index need not be further consulted.

It may not be possible to machine the first tooth to the full depth owing to interference from the tooth below, but when the remaining teeth have been relieved it will be found that the machining of this tooth can then be completed.

Where a cross-slide stop is not fitted, great care must be taken to cut all the teeth to exactly the same depth by making use of the cross-slide index.

As the machining of each tooth is completed, the clamp-nut on the arbor is slackened and the cutter is advanced one tooth on the register pin; the clamp-nut is then retightened, and this procedure is continued until all the teeth have been relieved, thus finishing the machining of the cutter.

Hardening the Cutter

The next operation is to harden and temper the cutter, and after the teeth have been sharpened, as will be described later, the cutter will be ready for use.

Before the carbon-steel cutter is hardened, it may be found advisable to anneal it to remove stresses present in the material. As an alternative, the cutter blank or the material as a whole can be annealed before the teeth are machined; this procedure has the advantage that the cutting edges are not damaged by the scaling of the metal which normally occurs during the heating process. Furthermore, annealing will remove any undue hardness of the steel which would increase the difficulty of machining the cutter blank.

Annealing is carried out by heating the steel to a bright red and then allowing it to cool very slowly. A small electric furnace, designed to attain the temperature required, will provide an ideal means of heating small components like gear-cutters, but a gas blow-pipe or petrol or paraffin blow-lamp will be found satisfactory for this purpose, if the work is well packed round with pieces of fire brick or asbestos cubes in order to promote slow cooling. On the other

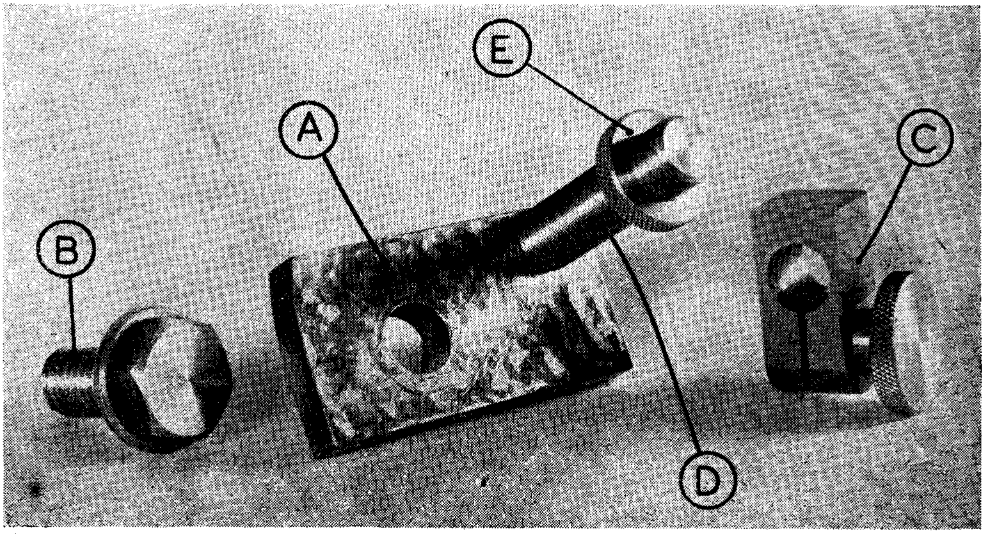


Fig. 33. *Component parts of the adjustable cross-slide stop*

hand, direct exposure in a coal fire may damage the steel owing to the sulphur present in the fuel.

After annealing, the temperature of the finished cutter is raised to a bright cherry red and it is then quickly quenched in cold water. A length of iron wire should be attached to the work to enable the cutter to be dipped into the water edge-first, for if the cutter is immersed while lying flat, it is possible that the sudden cooling will cause considerable distortion.

To make sure that the hardening operation has been effective, the heel of one of the cutter teeth should be tried with a file; if the file slides over the work surface without cutting, it may be assumed that the hardening is satisfactory; if, on the other hand, the tooth can be filed, then it is too soft and the cutter must be re-annealed

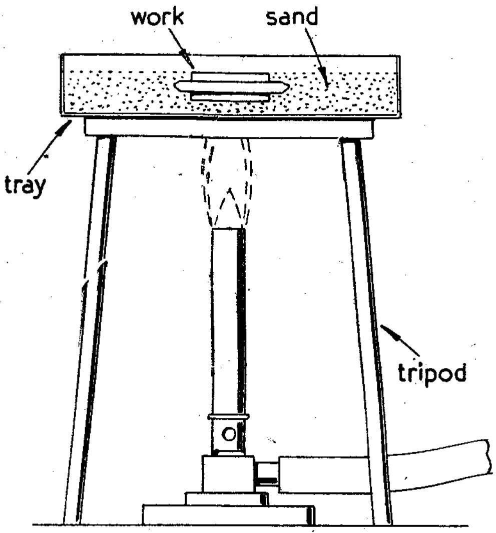


Fig. 34. *Apparatus for tempering cutters*

and afterwards hardened at a rather higher temperature.

The hardening, of course, leaves the teeth too brittle for use, and the cutter must be tempered before it can be put to work.

Tempering to a yellow or straw-yellow colour will in part remove the brittleness, but will leave the teeth sufficiently hard for machining steel gear wheels. It is important that the tempering operation should be conducted so as to heat the work evenly, thus leaving all the teeth with the same degree of hardness. This is, perhaps, most easily effected by heating the work in a sand bath, as it is termed, although a metal plate is sometimes used for this purpose by more experienced workers.

The illustration, Fig. 34, shows the type of sand bath in common use. The tray, resting on the tripod, contains a thick layer of fine, dry sand, and the heat is supplied by a gas Bunsen burner. To enable the colours forming on the surface of the heated steel to be readily identified, the cutter should be cleaned with a strip of worn emery cloth before being embedded in the sand with only its upper surface exposed. As the heat is applied, the surface of the work is carefully watched, and as soon as the required tint appears the cutter is quickly withdrawn and quenched in cold water.

Should the cutter have been made of mild-steel, it will have to be case-hardened and then tempered before use. For this purpose, several well-known case-hardening compounds are available and all will give satisfactory results. The compound "Antol" is especially useful, as it is quick in action, and, after quenching, the work is left with a smooth pearly-grey surface.

A thin layer of case-hardening can readily be obtained by covering the part with the compound and then heating it on the open hearth with the aid of a blow-pipe or blow-lamp; several applications of the compound should be made in order to increase the depth of the layer of hardening steel formed.

Where still deeper case-hardening is desired, the work is closely packed with the compound in an iron container, such as a discarded cast-iron piston or an old electric fuse box fitted with a cover. In this case, the container can be heated to a red heat in an open coal or coke fire for a period of half an hour or more, depending on the depth of hardened case required.

If several rods of the same material as the work are inserted through holes in the lid of the container into the hardening compound, one can be withdrawn at any time to test the progress of the case-hardening process. On withdrawal, the rod is quickly quenched and then broken across in the vice. The depth of the hardened layer will then be readily apparent from the alteration in the structure of the steel seen at the site of fracture. Whichever case-hardening method is used, the work at the end of the heating process is quenched in cold water, as when hardening ordinary carbon steel.

The case-hardening process must, in this instance, also be followed by a tempering operation carried out in the manner already described for carbon-steel.

Marking the Cutter for Identification

Although a gear-cutter can be identified, with regard to the diametral pitch and the number of gear teeth it is adapted to cut, by engaging it with the corresponding form tool, it may save time and unnecessary trouble if these particulars are marked on the cutter itself.

Likewise, to save having to measure the diameter and distance apart of the cutter pins of the form tool in order to establish its identity, it is advisable to indicate on the shank the exact purpose for which the tool is intended.

These particulars can be marked on the form tool with figure and letter punches; but where these are not available, and when the hardened gear-cutter has to be marked, an etching process is usually employed.

Metals can be readily etched by the application of strong acids, whilst to confine the action of the acid to the outlines of the figures or letters required, a substance, termed a resist, is applied

to the surface of the work and the inscription is scratched through this layer with a pointed tool or style.

Recipes culled from text books include pyroligneous acid, glacial acetic acid, Burgundy pitch, asphaltum and gum mastic as appropriate materials, but experience has shown that commercial nitric acid is a suitable etching fluid and beeswax an excellent resist.

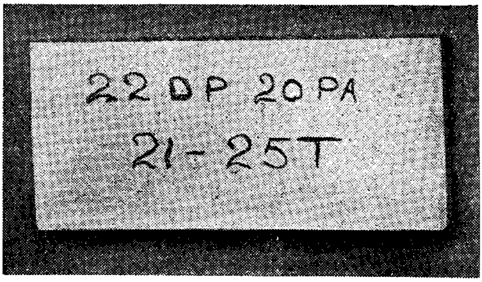


Fig. 35. *An inscription etched on steel*

Before applying the wax, the surface of the metal should be well cleaned with metal polish to remove any grease. The work is then warmed over a spirit lamp and the wax is rubbed on until a flat, even coating is formed. For fine writing, an ordinary sharp scriber can be used but if thicker lettering is required a style with a rounded or square point will give better results ; at the same time, care should be taken to ensure that the marking tool penetrates right through the wax and exposes the surface of the underlying metal.

The etching is best carried out with diluted nitric acid, using one part of acid to two parts of water. The acid is applied with a small piece of cotton wool twisted on to the end of a match stick to form a swab ; this enables the inscribed furrows to be filled with acid without damaging the wax coating.

As soon as the acid attacks the metal, bubbles will appear, and after a time these should be brushed away with the swab to bring fresh acid into action.

It will usually be found that the etching has reached a sufficient depth after the acid has been in contact with the metal for half an hour. The work is then well washed in water to remove all trace of acid, and the wax is brushed off with a rag moistened with lighter fluid.

The appearance of a piece of steel etched in this way is shown in Fig. 35, but the irregularity of the lettering is due to indifferent writing and not to any fault in the process itself.

Nitric acid, it should be remembered, not only attacks steel, but will also burn holes in the skin or clothing with equal facility.

To avoid any possibility of error, it is advisable, as illustrated in the photograph, to inscribe both the form tool and the cutter with its diametral pitch, also the pressure angle and the number of gear wheel teeth it is adapted to cut.

On larger work and where neat lettering is essential, a stencil may be used instead of freehand writing.

The smallest size Uno stencils used by draughtsmen have capital letters and figures only 3/32 in. in height, and when these are used as an aid to engraving, a style of the same diameter as the standard Uno pen should be employed for tracing the inscription.

Before the cutter is brought into use, it is advisable to sharpen the cutting edges of the teeth ; in the next article, therefore, a simple method of honing the tooth faces will be described which ensures accuracy without the need of employing a cutter grinding machine.

(To be continued)

"In Town Tonight"

THE spectacle of a dark green van, somewhat resembling an ambulance, surrounded by a dozen or so cars, with the whole of the local population and most of the local constabulary in attendance, does not necessarily indicate a road accident or murder. On July 9th, some members of the Society of Model and Experimental Engineers were witness to the fact that it can mean merely that the B.B.C. is going visiting ; and on this occasion, two venturesome members of the constabulary, following the tangle of cables down to the basement of No. 20, Nassau Street, W.1, found themselves in the society's smoke-filled workshop. Having approved, with some misgivings, the spectacle of the society's engine No. 1928 churning away laboriously at the rollers of the new test stand, the applied load of 40 lb. giving rise to a shattering display of noise and vibration, they returned hurriedly to the purer atmosphere and safer occupation of directing cruising taxicabs clear of the model traction engine which was bowling merrily up and down the street outside.

As an "Intownee," I am craving this small corner to place on record, on behalf of those in the society concerned in the broadcast, our appreciation of the courtesy, good humour, and patient understanding of our difficulties and limitations, shown by Mr. Brian Johnston and his technicians.—"1121."

An Electric "Pencil"

by S. A. Stead, B.Sc. (*South Australia*)

RECENTLY, it was necessary to number several dozen keys corresponding to a set of locks. No number punches were available; there were two alternatives: to etch the numbers or make up an electric "pencil." For the information of readers who may be interested, here are a few details which should enable one to be made up in half an hour or so.

The idea is that the article to be marked is connected to one terminal of a 6-volt accumulator (it does not seem to matter which). If a pointed conductor, connected to the other terminal is then brought into contact with the work and the two are separated, a small arc is produced, melting out and pitting the metals at the point of contact. By repeating this make-and-break a number of times, a line can be drawn in the metal. However, this method is crude and inefficient, making a very heavy drain on the battery. To overcome this defect, the marking point is made to vibrate rapidly and automatically by means of an electro-magnet, as is the case with the hammer of an electric bell.

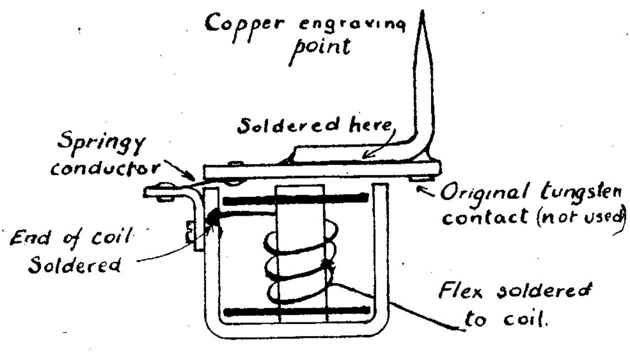


Diagram only of the connections for an electric "pencil"

An Old Cut-out

A discarded cut-out from the electrical system of a car will simplify the job considerably. One should be available from any garage for the asking, the smaller and more compact the mechanism the better. The cut-out is dismantled, the old windings removed from the bobbin and replaced by as much 18-s.w.g. copper wire (cotton-covered or enamelled) as can be wound in the space. If the heavy wire is not available, three strands of 22-s.w.g. wire wound on together makes a satisfactory substitute. One end of the coil is soldered securely to the metal frame of the late cut-out, the other end being soldered to a four-foot length of flex, terminated with a 50-amp battery clip.

Now we turn our attention to the vibrator. A piece of 8-gauge wire or $\frac{3}{16}$-in. copper wire about 2 in. long is pointed at one end and bent into an L-shape and soldered on to the vibrator on the side remote from the original tungsten contact. When the vibrator and electromagnet are reassembled the instrument is ready for use. A gramophone needle was tried as a substitute for the copper point, but showed a considerable tendency to stick to the metal being marked, short circuiting the battery. However, brass should prove to be suitable for the purpose. Better results are obtained when the copper tip is kept sharp, as it produces a neater line. For this reason, some readers may prefer to make a holder similar to the needle holder of a gramophone, but on a larger scale, thus making it possible to remove the tip for sharpening.

The metal to be marked should be brightened up with emery cloth, connected to the battery, and the design traced over with the point, the whole outfit being held in the hand just as a short thick pencil may be held. There will be a shower of sparks when steel is being marked, but they will not be so pronounced when the metal is brass or copper. Pressure should be light, the point just touching the work, depth of engraving being controlled to a certain extent by the rate at which the point is moved over the work—slow movement producing the deeper line.

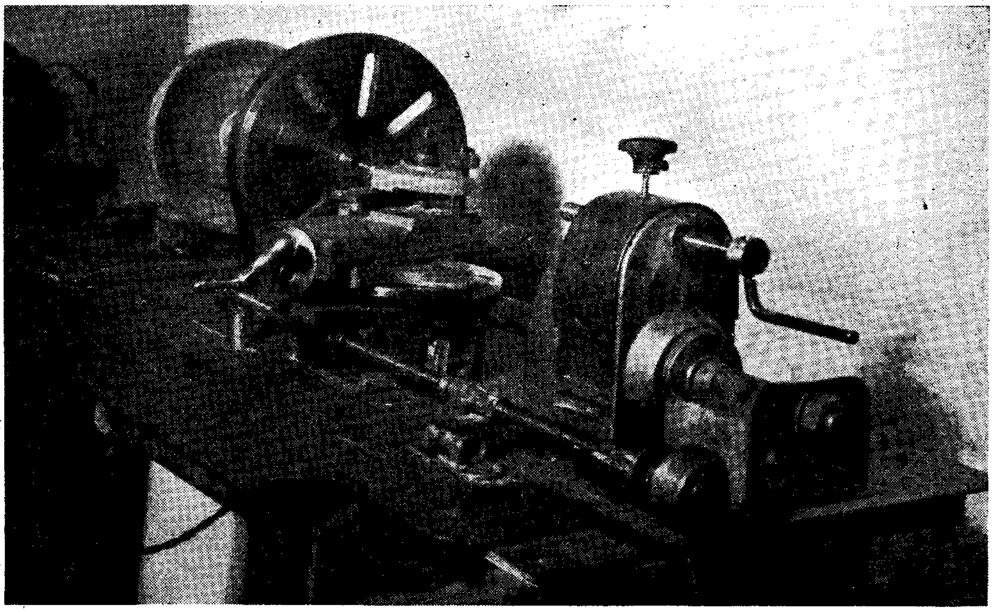
In Use

A few uses suggest themselves immediately; others will follow. Owners' names on tools may save confusion where several men use the same bench. The life of a file is longer when used new on brass only, later on steel and finally on the softer metals; a simple mark could be used on a file considered ready for use on steel. In the absence of a set of number or letter punches, the pencil becomes a useful substitute. It is ideal for marking steel which has been hardened, for the heating is so localised that the temper is not drawn even on small drills, often not clearly marked by the makers.

Some readers, who may make up one of these "pencils" may be keen to experiment on various tips for the marking point; perhaps they could pass on information gained to other readers through these pages.

A Home-Made Lathe

by A. Gilbert



I HAVE spent a great deal of time experimenting with various attempts at a home-made lathe, having always been anxious to possess a lathe, but never having the means of purchasing a real commercial product.

The lathe in the photograph is the outcome of these experiments, and is proving extremely useful and efficient. It started its career as a treadle machine, and has progressed until it is now driven by a ¼-h.p. a.c. motor. The only portions purchased ready-made were the pulley, faceplate and the top-slide of the tool rest. The remainder has been made up out of odds and ends.

The Bench

This is of stout wood, 2 ft. × 10½ in. and is covered with steel plate. The headstock is made up of a large cycle-hub with the original spindle and ball-bearings. This is bolted into a firm casting and to the bench, with an extra supporting bearing at the back to prevent springing. Behind this is the large pulley seen in the photograph, and at the back of this, again, is a smaller pulley and a carborundum wheel for grinding tools.

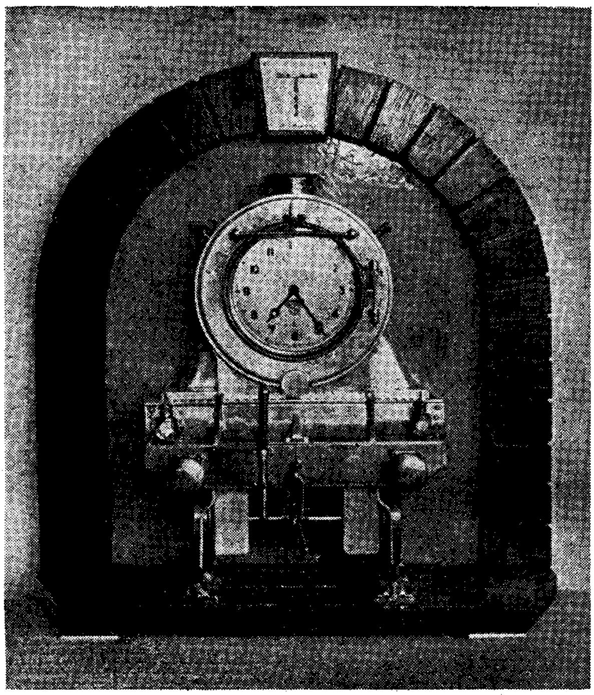
The adjustable slide-rest is built up on a steel casting adapted for the purpose, with a circular steel plate, and on this is bolted the adjustable top-rest with tool holder. A hand feedscrew passes through a ferrule attached to the front of the base of slide-rest, and is bracketed to the bench in three places, making a very firm and smooth-working job. A piece of steel tube, ¾ in. outside diameter forms the centre bed, and sliding a good fit on this is the tailstock, made from an old magneto casing, bored at the top to take the adjustable bolt, and again vertically for a set-screw to fix same. This makes a very sturdy fitting.

Chucks and Fittings

I have several home-made chucks and other fittings, all bored and screwed to fit the spindle of the cycle-hub. Several 1-in. steel ferrules bored and screwed to fit make good adaptors. The faceplate was purchased ready made, and is a great acquisition. The aforementioned tubular guide is 16 in. long, and is firmly secured to blocks and brackets each end. The height of centres is 4 in., and the distance between centres is 10 in.

The experience gained in developing this lathe has been invaluable, and I have been able to do a large number of jobs since completing it, both in ornamental work for the home, and mechanical jobs in connection with my hobby. The ¼-h.p. motor was bought second-hand for £1 as it would not work. It has had little use, however, and within an hour I had it working; it has given no trouble since. Slight adjustment and cleaning was all that it required.

A "Locomotive" Clock



HERE is a photograph and description of a locomotive clock received by my wife and I as a Christmas present in 1948. It was made by my father, Mr. Charles Thackray, of Horsforth, Yorkshire, who, "hiding his light under a bushel," would never have written this! However, the clock has caused so much comment, by those who have seen it, regarding the originality of subject and quality of workmanship, that I thought it might be of interest.

The locomotive front is not constructed to a prototype, but has many Great Northern characteristics. The clock is a "Smith's" 8-day car dashboard type and is mounted in the smokebox, which formerly saw service as a diesel engine piston. A new bezel was then made complete with hinge, lamp-bracket and rail, the smokebox mounted on a fabricated saddle and riveted to same. Chassis was constructed from 10-s.w.g. dural, and buffer-beam from angle fitted with spring buffers, coupling pipe and hook which has attached a finely-detailed coupling, even to minute split pins through the link blocks.

Running-board sheeting was then riveted to the chassis and valances included. Cylinders are fabricated from sheet and covers are small pressings. The chimney is turned from melted-down piston metal, and wheels (10 spokes) were cut from solid and highly polished. Two lamps are fitted, made from brass with lenses inserted, which are brilliants, and when light plays upon them the effect is very nice.

The clock is mounted on brass rail (the only commercially-made article beside the clock) which is on sleepers carved in relief from the baseboard, and is backed by the tunnel-mouth, the "stones" of which are three hacksaw-blade-widths apart. It is surmounted by an engraved plate giving date, initials, etc.

All metalwork is highly polished, the tunnel filling being light green and the woodwork is french polished.—C. S. THACKRAY.

The Coventry S.M.E. Regatta

(*Continued from page* 124)

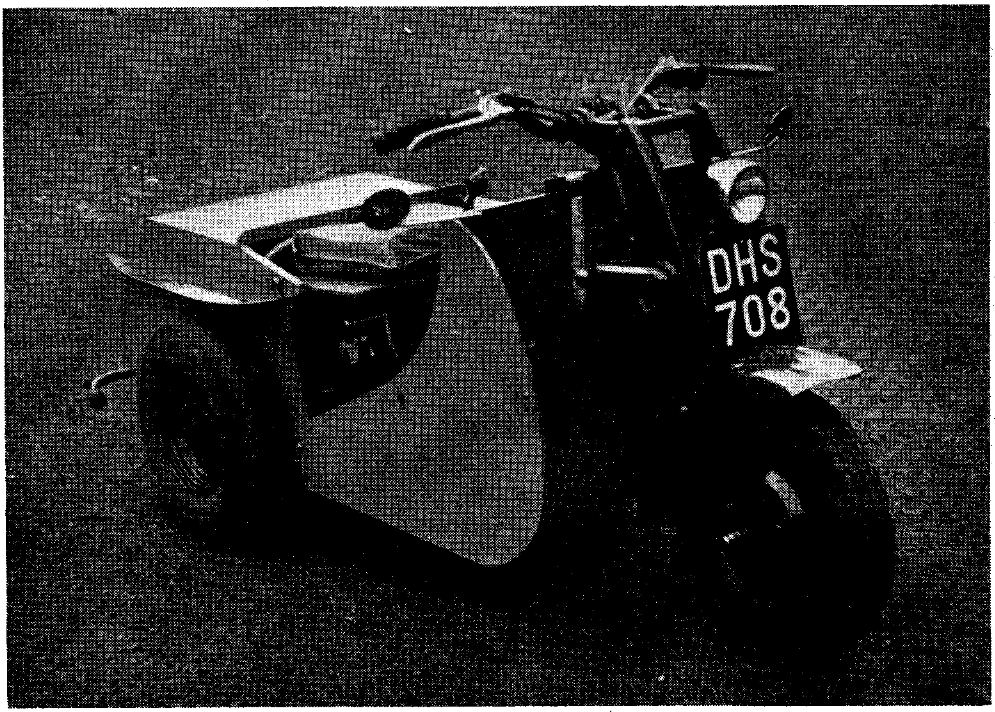
and brought almost to a standstill on the third attempt. This was adjudged "no run" and another run allowed. It looked as if the result of this would be much the same as the first two runs, but when within a few yards of the target, the propeller was again partially fouled—and the boat was steered neatly into the bull! This gave Mr. Vanner third place, with 7 pts.

Between events, demonstration runs were made by Mr. A. Welter's radio-controlled cabin cruiser *Aurora* (Northampton), and despite some slight trouble with the adjustments, which on two occasions caused the boat to lose control, the demonstration proved that the boat can be manoeuvred both ahead and astern and perform complicated steering evolutions under radio control. The transmitter works on a very small power input, at a frequency of 7 megacycles. Mr. V. H. Grey's radio-controlled boat was run at the regatta, but as it was entered in the steering competition, the control gear was, for obvious reasons, put out of action.

PRACTICAL LETTERS

A 3-Wheeled Motor Vehicle

DEAR SIR,—Mr. J. H. Ahern's letter published in the February 24th issue, and the two letters on the same subject, in the issue dated May 26th prompt me to send a photograph of a vehicle which I have built to fulfil "Minimum Personal Transport Requirements."



The power is supplied by a 98 c.c. J.A.P. industrial petrol engine, and transmitted to one of the rear wheels through a three-speed Albion gearbox, giving a road speed of about 15 m.p.h. in top gear.

The frame is a tube and angle structure, with the front wooden portion of the body used to maintain lateral rigidity. The sides and back of the engine cover may be removed by the withdrawal of six bolts, its top being hinged to allow access for day-to-day requirements such as filling with oil. The kick starter is reached by raising the seat.

Brakes are provided on the front and driving wheels.

Yours faithfully,

Kilbarchan. IAN FRASER-MARSHALL.

Tool Test Reports

DEAR SIR,—With reference to the proposed institution of a regular review of new tools and machines appearing on the market, I consider this idea is excellent, and, provided the information is of the right character, it will be of considerable benefit to the growing circle of individuals interested in model engineering.

Defining "information of the right character" I would suggest the comments be as definite and absolute as possible. So many descriptions are made up entirely of relative terms, e.g. "highly accurate," which, without some standard of comparison, means precisely nothing. If a lathe is, say, capable of turning to not more than 0.001-in. taper in 2 in. length, then an absolute indication is given which means much to the man interested in obtaining or using such a machine.

I know there is considerable difficulty in assessing the performance of various machines and tools, and I myself should have difficulty in putting forward a code of standards, but I would urge that in reviewing these matters, let us have comment that is more inclined to be absolute than nebulous comparison, and in particular in the case of lathes, let us have some indication of the diameter of M.S. bar the lathe will part off at a certain speed and certain distance from the front bearing (overhang).

Wishing every success to the new feature.

Yours faithfully,

Lincoln. J. RODWAY.

The "Eureka" Clock

DEAR SIR,—May I thank Mr. Thomas for pointing out the error in my letter published on April 7th? I should have seen this on re-reading.

I do not, however, agree that temperature compensation is not affected by moving any of the screws in or out. If a screw is moved out the balance is thown out of pose, i.e. it becomes heavier at this point. Therefore, if the screws at the free ends of the balance are moved out, it has the same affect as moving them nearer the ends. It is for this reason that, on high-class watches, two of the four mean-time, or quarter screws are fitted a little distance from the balance arm, as this is usually the calculated neutral point.

When compensation is carried out by the above method, mean-time adjustment will be necessary by moving the same number of screws at the other ends of the rims an equal amount in the opposite direction. This could be carried out instead by adjustment to balance spring.

It will be appreciated that compensation is a vast subject and rather beyond the scope of this journal. I feel that better results would be obtained by using an uncut balance together with an alloy spring such as "Elinvar" or "Nevarox," if obtainable.

Yours faithfully,

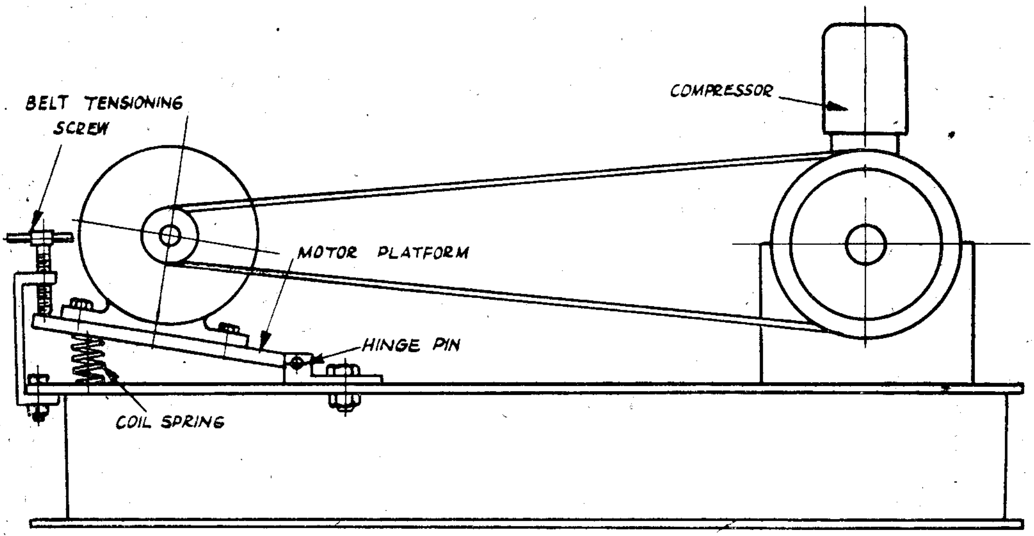
Cardiff. "WATCHMAKER."

A Motorised Compressor Unit

DEAR SIR,—I recently completed a high-pressure air compressor plant for spray painting, using war surplus material for most of it. The compressor was a 2-stage, water-cooled hymatic and my problem was to arrange electric drive, which could be used on an ordinary light circuit when required, for short periods.

The supplies of the compressor advocated a minimum of ¾ h.p. which ruled out a 5-amp. light circuit. However, I decided that ½ h.p. could do it if geared low enough, and a storage cylinder of suitable size was placed between the compressor and spray gun.

When I had assembled the plant I could not start the motor without blowing a fuse, although a push-button starter was employed. I found, however, that with a free belt, the motor would start and run without any trouble. I finally devised a very simple scheme, consisting of a hinged platform upon which the motor is bolted. Under the platform is a strong spring, which tends to force it upwards, thereby shortening the distance between the pulley centres and slackening the belt. A hand operated screw is fixed in such a way as to bear on the rear edge of the platform, so that when it is screwed down it forces the motor platform down, and slowly tightens the belt.



This scheme works perfectly, and in practice the belt tension is first relieved, the motor is then started and tension slowly applied until the compressor is running normally.

I find with a 5-to-1 reduction and single ½-in. vee-belt drive, I can pump up to 120 lb. per sq. in. in the storage cylinder, which is about 6 in. × 24 in. The air is taken through a reducing valve to an air dryer and thence to a M.P.S. Aerograph spray gun.

I have used this plant to cover large areas at one sitting, i.e., two rear wings and rear panels of a 9-h.p. car, and the storage pressure has never dropped below 60 lb., when using a gun pressure of 40 lb.

Yours faithfully,

Eastbourne. T. W. G. EADY.